THE X-RAY ATLAS OF THE SYSTEMIC ARTERIES OF THE BODY

BY

H. C. ORRIN

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BY

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PREFACE AND EXPLANATORY NOTE

In introducing this X-ray Atlas of the main Systemic Arteries of the body, an explanatory note as to its evolution and object is perhaps necessary. It is an adaptation to Anatomy of the methods employed by the Author in his original work of rendering visible the vascular system by X-ray.

The book has been produced in response to an appeal from the many who have perused his article on the subject published in March, 1919, in *The Archives of Radiology,* and illustrated therein by the first series of these anatomical radiographs. It has been prepared for the use of students of Anatomy, Surgical Anatomy, and Operative Surgery, and is intended to provide a series of natural illustrations of the Systemic Arteries in continuity, and precisely as they exist *in situ* in the undissected body.

The Plates, which constitute the main feature of the Atlas, are in every detail exactly as radiographed, the only additions being the pointers and indicating lines of each vessel.

It has been impossible to obtain access to an adult cadaver during the three years that these investigations have been carried on, and consequently resort has had to be made to a full-time fœtus for the production of the series of radiographs required to illustrate the Atlas. The Author's primary object in demonstrating the vascular system by means of X-ray is purely anatomical. No matter how well dissection is performed, complete continuity of the vessels ; their exact relationship to bones ; their finest terminal branches ; the series of anastomosis into which they enter are seldom if ever accurately displayed or intelligently appreciated by dissection alone.

The X-ray demonstration is enhanced also by stereoscopic radiographs, which provide the only possible means of accurately rendering visible the points and details specified. A series of these has been inserted for use at the end of the Atlas.

The text of the Atlas has been reduced to the necessary minimum.

Extracts have been borrowed from *Gray's Anatomy, Cunningham's Anatomy,* also from *Pocket Anatomy,* and the standard works on Surgical Anatomy. To the Authors of these books due acknowledgment is made.

The order in which the regions are dealt with is selected with a view to demonstrating, as far as possible, the complete continuity of the vessels, so as to link up more clearly and easily one region with another.

The arrangement adopted therefore is as follows :—

(1) Head and Neck, including the Arch of the Aorta.
(2) Upper Extremity.
(3) Thorax.
(4) Abdomen.
(5) Pelvis and Lower Extremity.

H. C. ORRIN.

93, Harley St., London, W.
April, 1920.

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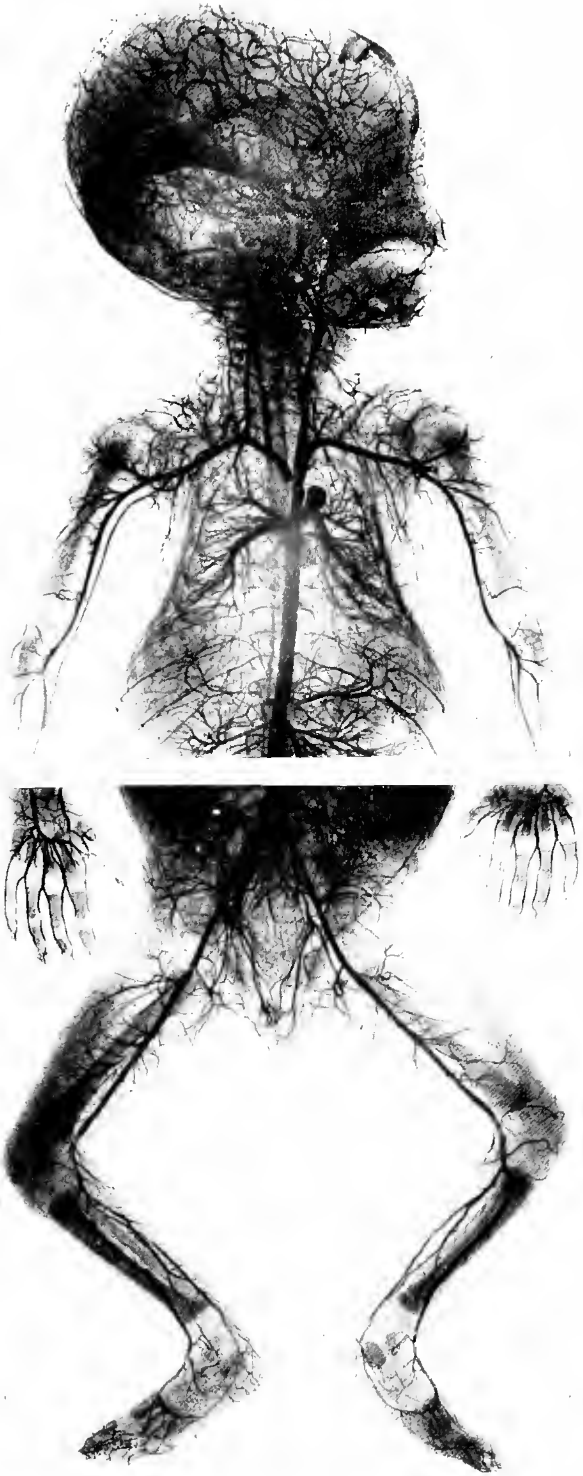
PLATE I

The Fœtus *in toto*

This plate is a reduction of the full-length photograph of the fœtus, radiographed in two parts, upper and lower halves. It is reproduced in order to exhibit the systemic vessels *in toto* and in complete continuity.

PLATE I



THE FŒTUS.

Showing Systemic Vessels in complete continuity.

1*

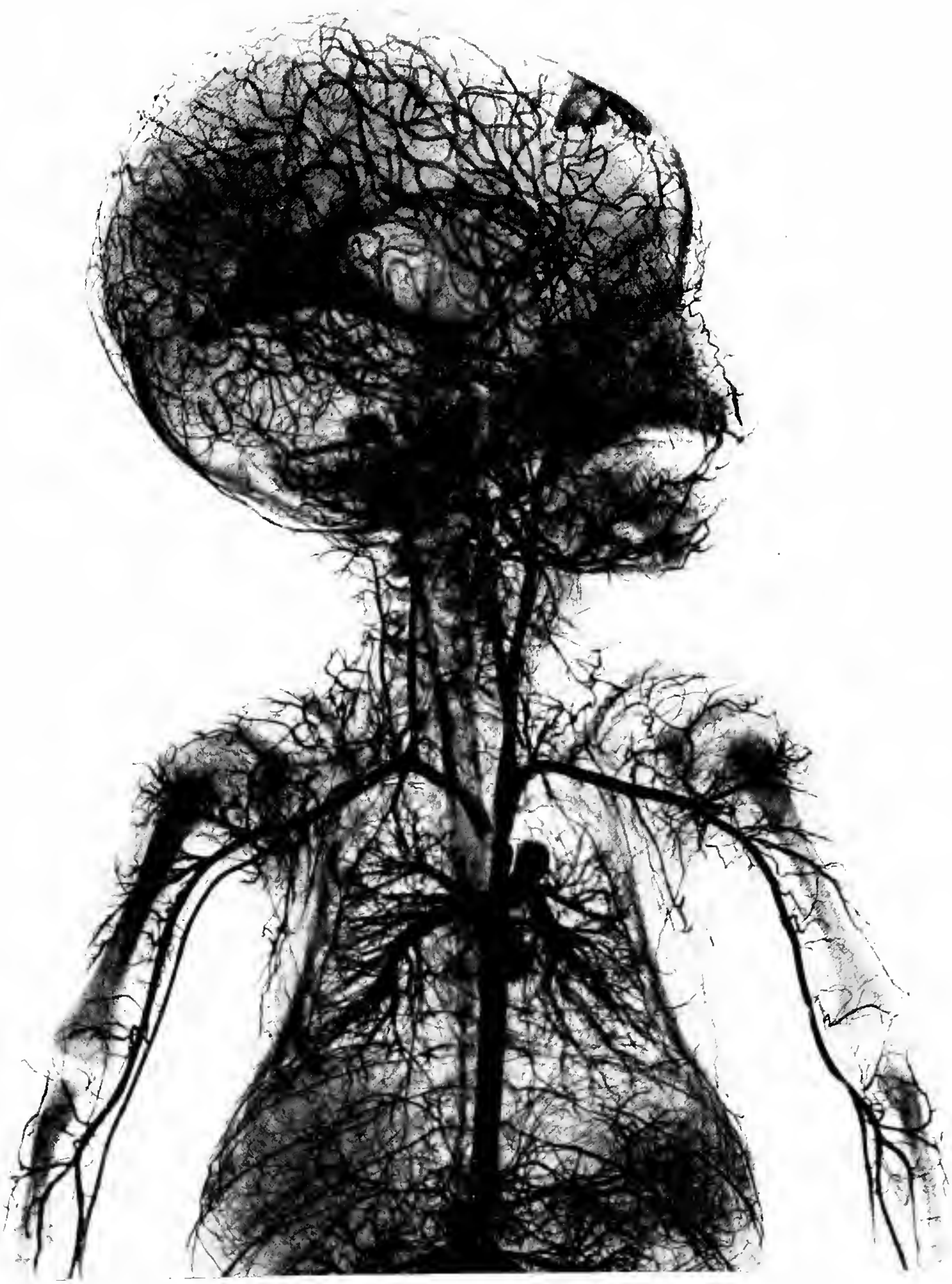
PLATE II

Systemic Vessels of Superior Half of Body

Plate II. is for reference only ; pointers, indicating lines and names of vessels being intentionally omitted.

When a vessel has been identified and located on its appropriate regional radiograph its origin, termination, extent and course can then be the more clearly traced and followed out on the reference plates of this or of that on page 3.

PLATE II



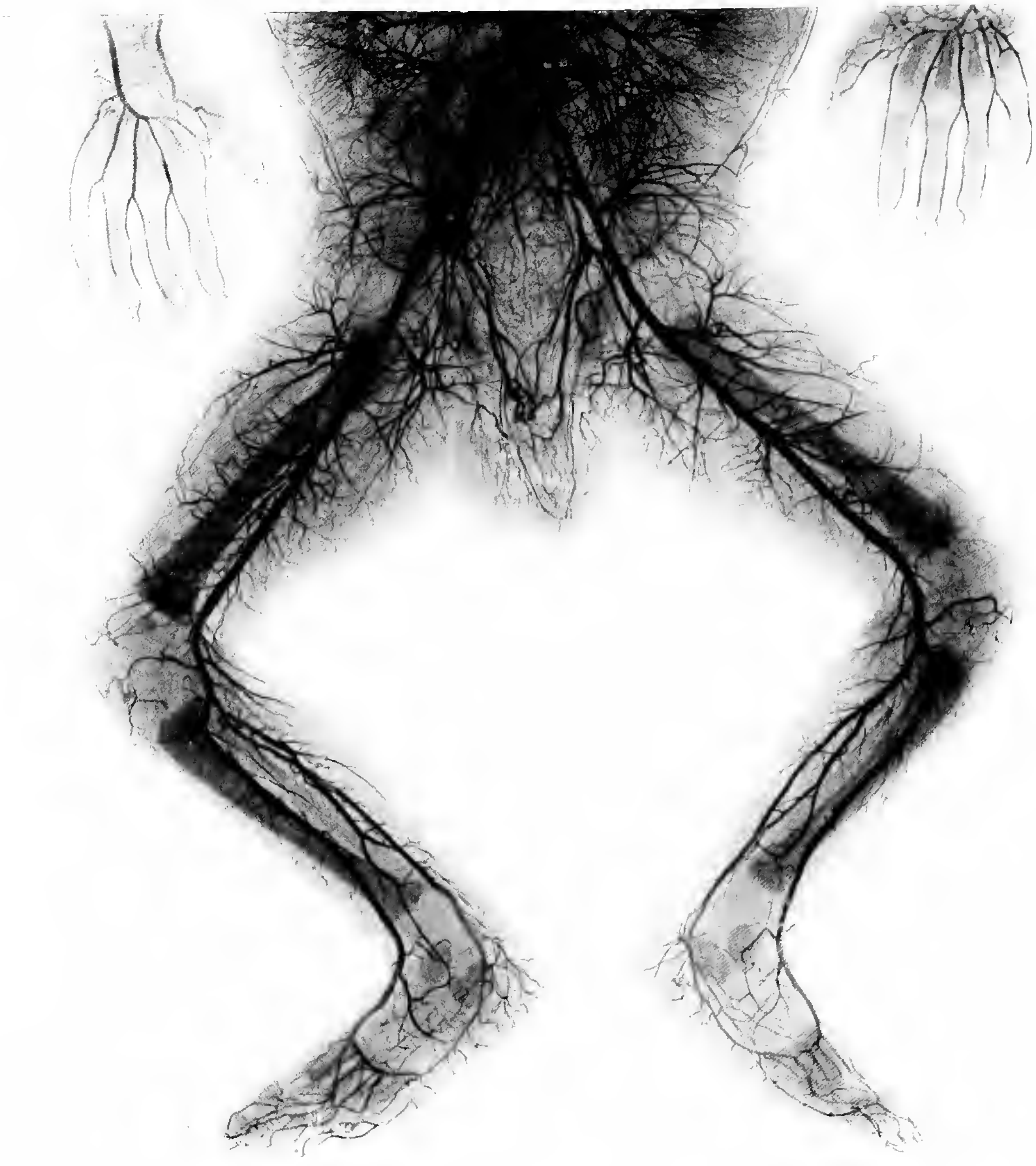
Vessels of Upper Half of Fœtus.

PLATE III

Systemic Vessels of Inferior Half of Body

As in the case of Plate II., this radiograph is for reference only. A detailed description and point of indication of each vessel is found under the appropriate regional text and radiograph.

PLATE III



VESSELS OF LOWER HALF OF FŒTUS.

PLATE IV

Head and Neck—including the Arch of the Aorta

The Aorta is the large main trunk of the systemic arteries. It is situated in the thorax, and, commencing at the left ventricle it arches over the root of the left lung, whence it descends into the abdomen. It is therefore conveniently divided into three distinct anatomical parts: (1) The Aortic Arch, (2) the Descending, and (3) the Abdominal Aorta. The two latter are dealt with in their respective regional parts, *vide* pages 48 and 56.

The Arch of the Aorta. As the aortic arch passes in two directions it is accordingly divided into ascending and transverse portions.

The Ascending or First Part arises from the base of the left ventricle at the level of the third left costal cartilage, and passes upwards and forwards to the right, touches the sternum at the upper border of the second right costal cartilage. At its root there is a dilation—in reality three bulgings—the sinuses of valsalva, which gives rise to the coronary arteries, so distributed to supply the substance of the heart itself. (*Vide* page 52, Plate XII.)

The Transverse or Second Part. This part runs in a much more antero-posterior direction than is usually imagined, arching over the root of the left lung and passing backwards to reach the left side of the body of the fourth dorsal vertebra.

Branches:—

The Innominate Artery commences at the right side of the transverse part of the aortic arch at a point which corresponds to the middle of the manubrium sterni, and extends upwards and to the right to the posterior aspect of the right sterno-clavicular articulation, where it bifurcates into the right subclavian and right common carotid. Its entire length is 1½″ to 2″.

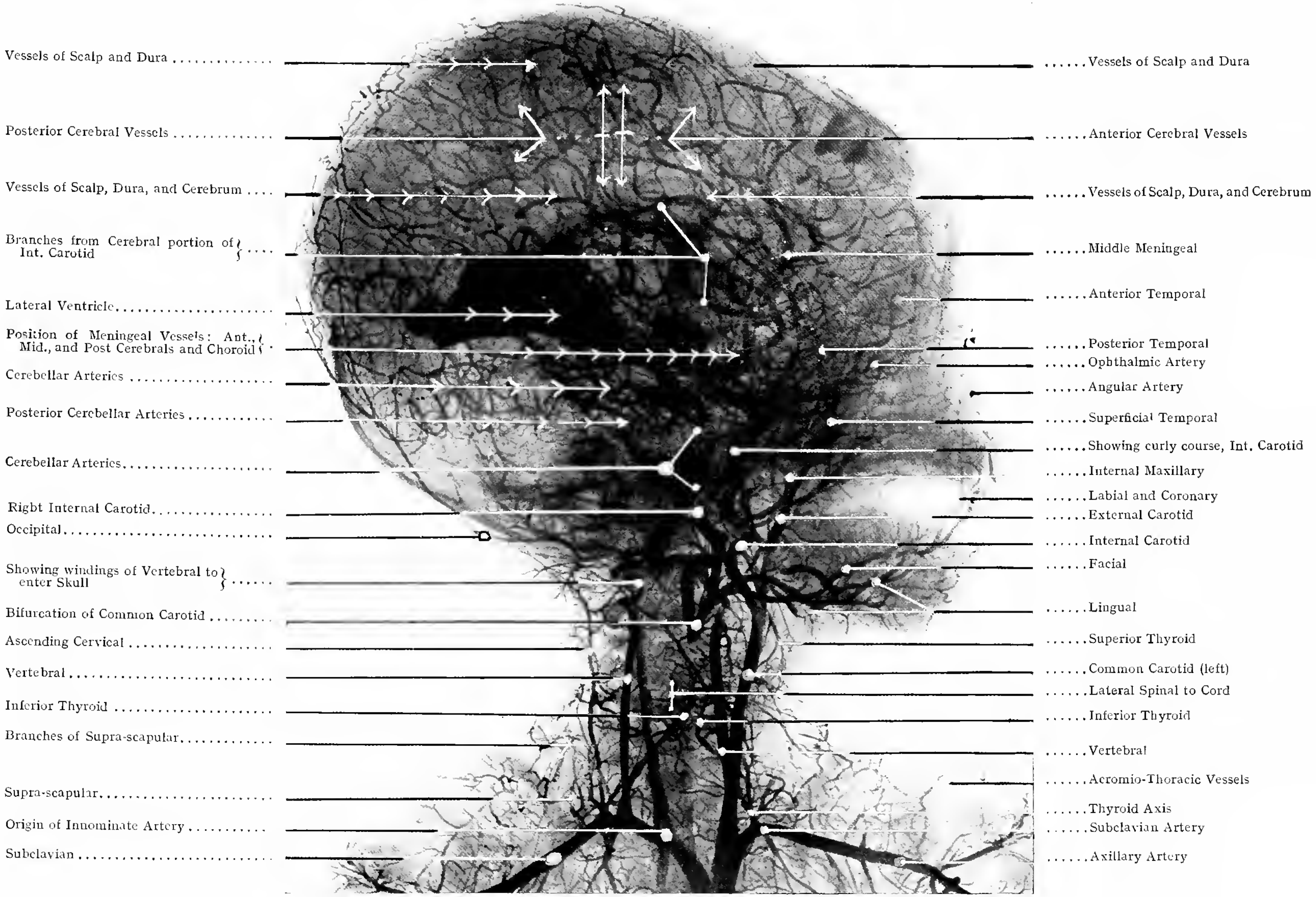
Branches: Occasionally the thyroidea ima, which passes in front of the trachea to the thyroid gland.

The Subclavian Artery on the *right* side commences from the branching of the innominate artery. On the *left* side directly from the arch of the aorta. It extends from the sterno-clavicular articulation to the external border of the first rib. It is divided into three parts by the scalenus anticus muscle—a part internal to (first part) a part behind (second part) and a part external to that muscle (third part). It crosses the lower part of the neck, arches over the pleura and first rib, and ends opposite the middle of the clavicle. It usually ascends about one inch above the level of the clavicle. The right subclavian is about 3″ long, and the left about 1″ longer.

Branches of the Subclavian—of the First Part:—

I. **Vertebral** arises from the upper and back part of the artery, and passes upwards to the foramen in the transverse process of the sixth cervical vertebra. The left vertebral

PLATE IV



Vessels of Head and Neck.

is usually the larger. It is crossed by the inferior thyroid artery on both sides. It enters the skull through the foramen magnum, winds round the medulla to its anterior aspect, and at the lower border of the pons unites with its fellow of the opposite side to form the basilar artery.

Its branches are **Cervical** and **Cranial : The Cervical** are lateral, spinal, and muscular.

The Cranial are : (1) Posterior Meningeal, (2) Posterior Spinal, (3) Anterior Spinal, (4) Posterior Inferior Cerebellar, (5) Bulbar.

II. **The Thyroid Axis.** This is a short trunk which arises from the anterior and upper part of the subclavian, and immediately divides into three branches.

(1) **The Inferior Thyroid,** which passes upwards and inwards in front of the vertebral artery but behind the carotid. It follows a tortuous course to the inferior angle of the thyroid body, which it enters on a level with the fifth cervical vertebra.

The Branches of the Inferior Thyroid are : (1) Ascending Cervical, (2) Inferior Laryngeal, (3) Œsophageal, (4) Tracheal.

(2) **Transversalis Colli** or **Transverse Cervical** passes outwards over scaleni muscles into posterior triangle of the neck, and ends by dividing into superficial cervical and posterior scapular arteries.

(3) **The Supra-scapular.** This vessel runs downwards at first, crossing the third part of the subclavian ; then runs transversely outwards behind and parallel to the clavicle to the upper edge of the scapula, to pass over the transverse ligament on the supra-scapular notch, enters supra-spinous fossa, winds over the neck of the scapula to infra-spinous fossa. It anastomoses with posterior scapular and dorsalis scapulæ.

Its branches are : (1) Muscular, (2) Supra-acromial, (3) Subscapular, (4) Infra-spinous.

III. **Internal Mammary.** (*Vide* section on Thorax, page 48, Plate XI.)

Branches of Subclavian—of the Second part :—

The Superior Intercostal Artery. (*Vide* section on Thorax, page 48, Plate XI.)

The Carotid Vessels :—

The Common Carotid on the right side commences in the bifurcation of the innominate ; on the left side it springs direct from the aortic arch. It extends from behind the sterno-clavicular articulation to the upper border of the thyroid cartilage, where it divides into internal and external carotids.

The branches of the common carotid are terminal only, viz. external and internal carotids.

The External Carotid extends from the bifurcation of the common carotid opposite the upper border of the thyroid cartilage to the level of the neck of the condyle of the lower jaw, where it divides into superficial temporal, and internal maxillary arteries. It is called "External" because it is distributed to the outer aspect of the cranium.

Branches of the External Carotid :—

An Anterior set : (1) Superior Thyroid, (2) Lingual, and (3) Facial.

A Posterior set : (1) Occipital, (2) Posterior Auricular, and (3) Sterno-mastoid.

An Ascending set : (1) Temporal, (2) Internal Maxillary, (3) Ascending pharyngeal. The Sterno-mastoid branch may possibly arise from either the external carotid, the occipital, or the superior thyroid.

The Superior Thyroid arises just below the great cornu of the hyoid bone, and curves downwards and forwards to the thyroid body. It anastomoses with its fellow of the opposite side and with the inferior thyroid.

Branches: (1) Hyoid, which runs inwards below the hyoid bone ; (2) the Sterno-mastoid, which passes outwards across the carotid sheath to the sterno-mastoid muscle ; (3) Superior Laryngeal ; (4) Crico-thyroid, which runs across the crico-thyroid membrane ; (5) Terminal branches to the thyroid body.

Lingual arises from anterior aspect of artery between the superior thyroid and facial arteries, either just above or immediately below the great cornu of the hyoid bone ; passing upwards and forwards to the tip of the tongue as the ranine artery, ending at the side of the frænum linguæ.

Branches : (1) Hyoid runs along the upper border of the hyoid bone ; (2) Dorsalis Linguæ, which ascends to the dorsum of the tongue ; (3) Sublingual runs forwards and outwards to sublingual gland ; (4) Ranine is the direct continuation of the lingual.

All these branches anastomose with their fellow of the opposite side.

Facial artery arises from the external carotid artery a little above the lingual near the angle of the inferior maxilla, and passes forwards and upwards to the base of the lower jaw, over which it ascends to the face immediately in front of the masseter muscle. After this its direction is towards the angle of the mouth, the angle of the nose, and the inner angle of the eye, but in a very tortuous manner. It anastomoses with the ophthalmic artery.

Branches—In neck : (1) Inferior or ascending palatine ; (2) Tonsilar ; (3) Glandular to submaxillary gland ; (4) Submental arises as the artery turns round the base of the jaw and runs forward to the symphysis, there dividing into superficial, which turns round the chin, anastomosing with the inferior labial and mental, and a deep branch which anastomoses with the sublingual. **On the face :** (1) Muscular ; (2) **Inferior Labial,** which supplies lower lip and chin, anastomosing with the inferior coronary, submental, mental ; (3) The two **coronary arteries :** superior and inferior, which pass along the free margin of each lip, and anastomosing with its fellow of the opposite side ; (4) Lateral nasal to the side of the nose ; (5) **Angular**, its terminal branch anastomosing at the inner angle of the orbit with the nasal branch of the ophthalmic.

Posterior branches of External Carotid :—

Occipital artery arises from the external carotid at its posterior aspect, about opposite the facial, and runs upwards and backwards to a point between the transverse process of the atlas and the mastoid process of the temporal bone, then backwards in the occipital groove, and finally it ascends to the back of the scalp.

Branches : (1) Muscular, sterno-mastoid branch ; (2) Mastoid ; (3) Posterior Meningeal, which enters the skull through the jugular foramen ; (4) Princeps Cervicis, which passes downwards and divides into a superficial and deep part, anastomosing with the vertebral and profunda servicis of superior intercostal artery ; (5) Cranial or occipital to scalp, which anastomoses with the corresponding branch from the opposite side and with the temporal arteries and posterior auricular.

Posterior Auricular arises near extremity of styloid process and takes an ascending course, dividing into anterior or auricular, which anastomoses with the posterior division of the temporal ; and a posterior or mastoid branch, which anastomoses with the occipital.

Branches : (1) Stylo-mastoid, which enters the stylo-mastoid foramen and supplies the middle ear, mastoid cells and semi-circular canals; (2) Auricular, which is distributed to the back of the cartilage of the ear.

Ascending branches of External Carotid :—

Ascending Pharyngeal arises near the origin of the external carolid and ascends by the side of the pharynx and between the internal carotid to the base of the skull.

Branches : These are distributed to the muscles in this region and to the dura mater, and to the pharynx: (1) Prevertebral; (2) Pharyngeal branch supplies the soft palate and tonsil and anastomoses with the ascending palantine of the facial; (3) Meningeal.

Terminal branches of External Carotid :—

Superficial Temporal is the smaller of the two terminal branches of the external carotid. It arises in the parotid gland, and passes upwards over the root of the zygoma in front of the ear for a distance of one and a half inches, when it divides into its two terminal branches anterior and posterior, which pass in directions indicated by their names.

Branches : (1) Parotid; (2) **Transverse Facial,** which is given off in the substance of the parotid gland, and runs forward over the masseter muscle just below the zygoma and anastomoses with the infra-orbital and facial; (3) **Middle Temporal,** which perforates temporal fascia and supplies the temporal muscle—this vessel sometimes gives off an orbital branch which passes to the outer angle of orbit; (4) Anterior, auricular to anterior part of external ear, anastomosing with the posterior auricular; (5) **Anterior Temporal,** one of the terminal branches, anastomosing with frontal and supra-orbital; (6) Posterior Temporal, which curves backwards and anastomoses with its fellow of the opposite side and the posterior auricular and ocupital.

Internal Maxillary. This vessel is the larger of the two terminal branches. It arises in the parotid at the back of the lower jaw, and is divided anatomically into three portions. (1) **The Maxillary portion** lies between the neck of the jaw and the internal lateral ligament; (2) the Pterygoid portion, which passes forwards and outwards either between the two pterygoid muscles or the external pterygoid and the temporal muscles; and (3) the Spheno-maxillary portion, which enters the spheno-maxillary fossa.

Branches : From the Maxillary portion. (1) Tympanic; (2) Middle or great meningeal, which enters the skull through the foramen spinosum of the sphenoid bone and divides into two branches, an **anterior,** which passes to the anterior inferior angle of the parietal bone; and a **posterior,** to the squamous portion of the temporal, anastomosing with its fellow of the opposite side and the anterior and posterior meningeal.

It is the anterior branch which possesses the greatest interest from a surgical point of view.

The middle meningeal gives off the Gasserian to the ganglion; the Petrosal, the Orbital, and the Temporal, which joins the branches of the deep temporal through the bony foramen.

Small Meningeal through foramen ovale, supplying Gasserian ganglion and dura mater.

Inferior Dental, which accompanies the inferior dental nerve into the dental canal of the lower jaw, anastomosing with sub-mental, inferior labial and inferior coronary. It also gives off a mylo-hyoid and a lingual branch.

Branches from Pterygoid portion. All muscular: (1) Deep Temporal, anterior and posterior, (2) Pterygoid, (3) Buccal, (4) Masseteric, which reaches the masseter by passing over the sigmoid notch.

Branches of Spheno-maxillary portion : (1) **Posterior Superior Dental** or alveolar, which is given off as the artery passes into spheno-maxillary fossa—**Infra-orbital** is the direct continuation of the trunk, and passes through the infra-orbital canal, anastomosing with the facial and buccal; (2) Descending or superior palatine; (3) Vidian; (4) Pterygo-palatine; (5) Nasal or spheno-palatine, which gives a branch, the naso-palatine or artery of the septum, which runs along the vomer.

The Internal Carotid extends from the bifurcation of the common carotid opposite the upper border of the thyroid cartilage to the Sylvian fissure of the brain, where it divides into anterior and middle cerebral. It is called "Internal," because it is distributed to the interior of the cranium. It passes directly upwards to the carotid canal of the temporal bone, which it enters, passing upwards, then forwards and inwards alongside the sella turcica in the cavernous sinus, and finally upwards, and dividing at the anterior perforated spot into its branches. The cervical portion gives off no branches.

From the Petrous portion arises the tympanic branch.

Branches from the Cavernous portion : (1) Pituitary, (2) Meningeal, (3) **Ophthalmic,** which enters the orbit through the optic foramen to the inner angle of the orbit, where it divides into its two terminal branches, frontal and nasal.

Branches of Ophthalmic before division : (1) Lachrymal; (2) Central of Retina; (3) Posterior Ciliary—two sets—short and long; (4) Supra-orbital, which ascends to supra-orbital foramen, through which it passes and ascends over frontal bone, anastomosing with the temporal, facial and frontal arteries; (5) Superior and Inferior Muscular branches; (6) Anterior and Posterior Ethmoidals; (7) Palpebral.

Terminal Branches : (1) Frontal, which turns upwards round the inner margin of the orbit, anastomosing with the supra-orbital; (2) **Nasal,** which passes to the root of the nose, anastomosing with nasal and angular of facial.

Branches from Cerebral Portion of Internal Carotid :—

Anterior Cerebral, which passes forwards in great longitudinal fissure.

Middle Cerebral, largest branch, which divides into Internal and **External branches** for interior of brain and its external surface.

Posterior Communicating, which runs backwards, anastomosing with posterior cerebral of the basilar.

Anterior choroid, from the back part of the artery, entering the descending horn of the lateral ventricle and supplies choroid plexus.

The Basilar Artery is formed by the union of the two vertebral arteries; it divides at the upper border of the pons into the two posterior cerebrals.

Branches : (1) Transverse, (2) Anterior Inferior Cerebellar, (3) Superior Cerebellar, (4) Posterior Cerebrals—right and left, one on each side.

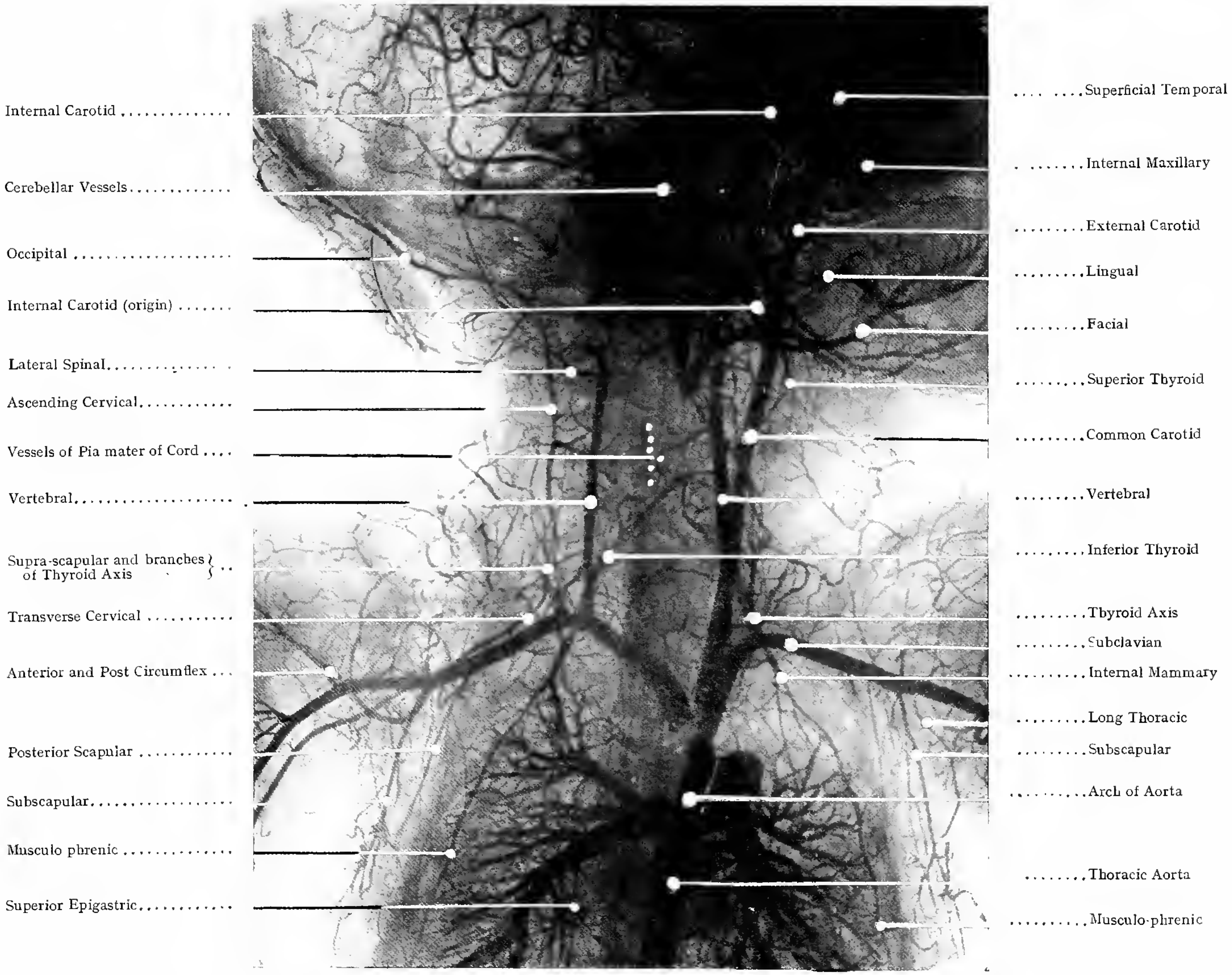
The Circle of Willis is the name given to the anastomosis between the vertebral and the internal carotid arteries at the base of the brain. The internal carotid sends forward the anterior cerebrals, which are connected by the anterior communicating. The basilar sends forward the posterior cerebrals, which are joined to the carotids by the posterior communicating arteries.

PLATE V

Head and Neck (Lateral View)

This plate shows a more lateral aspect of the base of the skull—middle and posterior fossæ—and of the neck than is seen in Plate IV. The superior and inferior branches of the subclavian and axillary arteries are more clearly brought into prominence, whilst the thoracic branches of the latter series of vessels can be fully followed out.

PLATE V



HEAD AND NECK (Lateral View).

PLATE VI

Vessels of Upper Extremity

The Axillary Artery. (*Vide* Plate IX., page 41.)

The Axillary Artery is the direction continuation of the subclavian, and extends from the outer border of the first rib to the lower border of the insertion of the teres major. It is divided into three parts, a part above, a part beneath, and a part below the pectoralis minor.

Branches : From the first part: (1) Superior Thoracic arises opposite first intercostal space and anastomoses with the internal mammary and intercostals; (2) Acromio Thoracic or thoracic axis, situated at the upper part of the pectoralis minor, and has the following branches: (1) **Acromial,** anastomosing with supra-scapular and posterior circumflex; (2) **Humeral,** which anastomoses with the anterior circumflex; (3) **Thoracic,** to supply side of thorax. anas. intercostal; (4) **Clavicular.**

From the Second Part : (1) **The Long Thoracic** or external mammary, which runs along in the anterior fold of the axilla at the lower border of the pectoralis minor to the mammary region, anastomosing with the intercostal and other thoracic branches; (2) Alar Thoracic.

From the Third Part : (1) **The Subscapular Artery,** which runs along in the posterior fold of the axilla at the lower border of the subscapularis muscle.

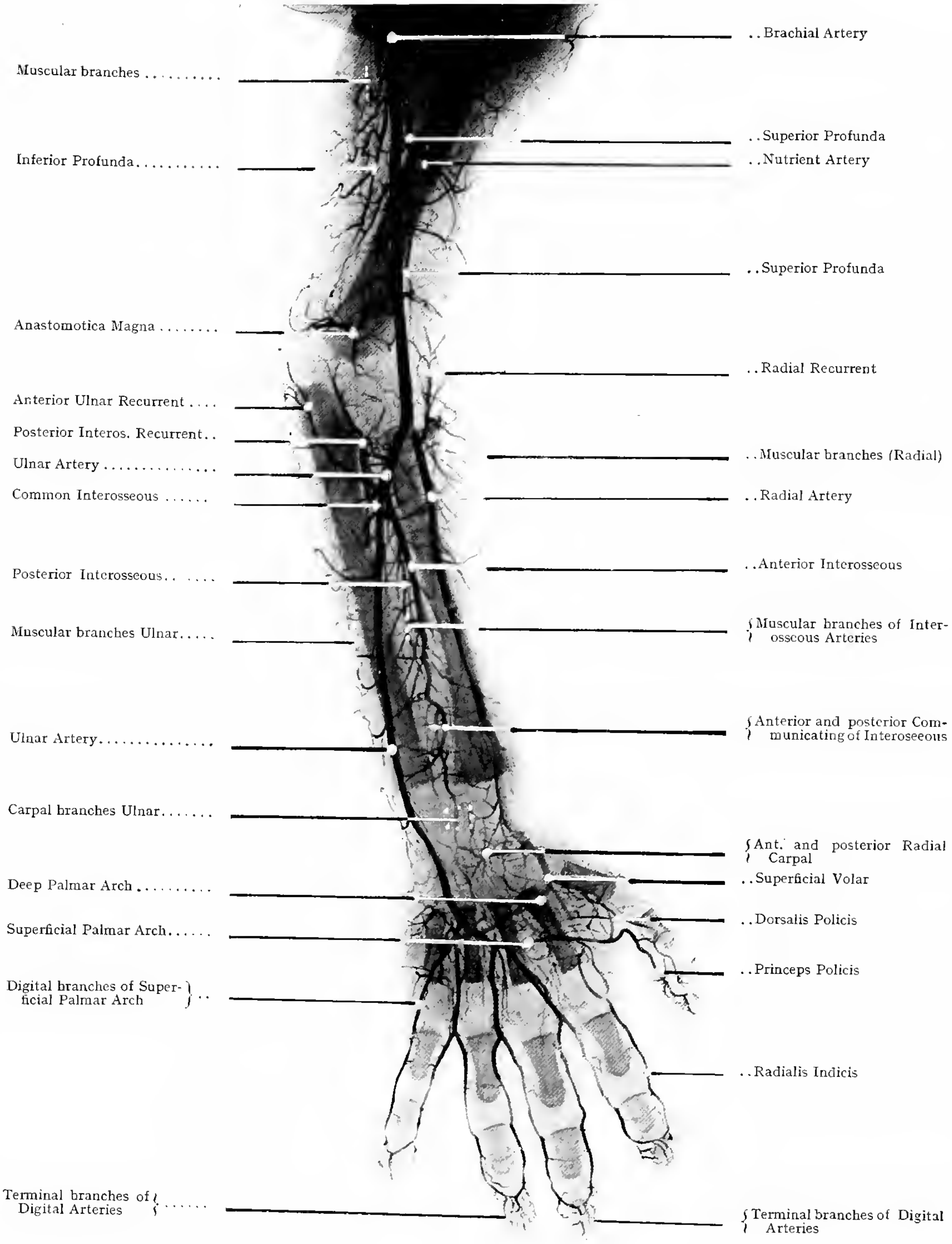
Branch : Dorsalis Scapulæ, which passes backwards to the infra-spinous fossa. It gives off ventral branches to the subscapular fossa and a descending branch to the angle of the scapula. It anastomoses with the supra-scapular and posterior-scapular.

From the Third Part; (1) **Posterior Circumflex** arises from the posterior aspect of the artery opposite the lower border of the subscapularis, and winds backwards around the neck of the humerus. It anastomoses with the acromio-thoracic, anterior circumflex, and superior profunda. (2) **Anterior Circumflex** arises from the outer side of the artery and gives a branch which ascends in the bicepital groove to shoulder-joint, and another which winds round the surgical neck of the humerus anastomosing with the posterior circumflex. These two arteries, anterior and posterior circumflex, thus encircle the surgical neck of the humerus, and must be carefully kept in mind in excision of the shoulder-joint.

The Brachial Artery is the direct continuation of the axillary (for description of the latter, *vide* above, Plate IX.). It extends from the lower border of the teres major to a point opposite the neck of the radius, about half an inch below the bend of the elbow, where it divides into radial and ulnar arteries. It at first lies to the inner side of the humerus, but gradually turns to the front of that bone. Its branches are :—

Superior Profunda is given off about an inch below the teres minor and winds backwards and outwards with the musculo-spiral nerve in the musculo-spiral groove. It gives off an anterior branch, which pierces the external intermuscular septum, anastomosing with the radial recurrent, and ends as posterior branch behind external

PLATE VI



VESSELS OF UPPER EXTREMITY (LEFT ARM).

condyle, anastomosing with the posterior circumflex, the interosseous recurrent, and the anastomotica magna.

Nutrient to the humerus which arises opposite the middle of that bone and enters the medullary foramen at that point.

Inferior Profunda, given off below the superior profunda, and accompanies the ulnar nerve piercing the intermuscular septum. It anastomoses with the posterior ulnar recurrent and the anastomotica magna.

Anastomotica Magna arises about two inches above the elbow joint and divides into two branches, one passing to the front of the internal condyle, the other behind the joint, the former anastomosing with the inferior profunda and anterior and posterior ulnar recurrent, the latter with the superior profunda.

Muscular branches to coraco-brachialis, biceps, brachialis anticus. It should be observed that all the **named** branches come off the inner side of the artery.

The Radial Artery commences at the bifurcation of the brachial artery at the bend of the elbow, and extends until it ends in the deep palmar arch. Its branches are :—

Radial Recurrent, which arises just below the elbow and takes an ascending course to anatomose with the superior profunda.

Muscular to muscles on radial side of forearm.

Superficialis Volæ. This vessel usually arises just as the radial is about to wind round the wrist ; it is usually small, and ends in the muscles of the thumb. It anastomoses with the ulnar, thus completing the superficial palmar arch.

Anterior Carpal arises near lower border of the pronator quadratus, passes inwards to anastomose with the anterior carpal of ulnar.

Posterior Carpal arises beneath extensor tendons of thumb.

Metacarpal (first dorsal interosseous) arises near posterior carpal and supplies adjoining sides of index and middle fingers.

Dorsalis Pollicis—two in number—arising near base of first metacarpal and courses along both sides of the dorsum of thumb.

Dorsalis Indicis. This vessel courses along the radial side of dorsum of index finger.

Princeps Pollicis arises as the artery enters the palm of the hand and courses along the first metacarpal to the base of the first phalanx, where it divides into two terminal branches, which run along the sides of the palmar surface of the thumb.

Radialis Indicis arises near to the princeps pollicis and runs to the outer side of the index finger, sending a branch to the superficial palmar arch. It anastomoses with the digital of superficial palmar arch.

Deep Palmar Arch. (*Vide* page 36, Plate VIII.)

The Ulnar Artery commences at the bifurcation of the brachial and ends in the superficial palmar arch.

Branches :—

Anterior Ulnar Recurrent arises near bifurcation of brachial and takes an ascending course, anastomosing with the inferior profunda and the anastomotica magna.

Posterior Ulnar Recurrent. This arises below the anterior branch and ascends behind the internal condyle, and anastomoses with the inferior profunda and the anastomotica magna.

Muscular branches to muscles on ulnar side of forearm.

Anterior Carpal runs under flexor profundus tendons, anastomosing with anterior carpal of radial.

Posterior Carpal arises just above pisiform bone and winds backwards, giving a branch to inner side of fifth metacarpal, thence passing outwards to anastomose with posterior carpal of radial forming posterior carpal arch.

Superficial Palmar Arch. (*Vide* page 36, Plate VIII.)

Common Interosseous.

The common interosseous branch of the ulnar artery is about half an inch long, and arises just below the radial tubercle and passes to the interosseous membrane, where it divides into two terminal branches.

(1) **Anterior Interosseous** passes down the forearm upon the anterior surface of the interosseous membrane. At the upper border of the pronator quadratus it divides into two branches, one, the anterior communicating goes down beneath the quadratus and anastomoses with the anterior carpal and deep arch ; the other branch pierces the interosseous membrane and descends on its posterior surface to the back of the carpus, anastomosing with the posterior interosseous and the posterior carpals of radial and ulnar.

It also supplies a nutrient branch to radius and ulnar, and a branch to median nerve—the comes nervi mediani.

(2) **The Posterior Interosseous.** This branch of the common interosseous passes backwards between the oblique ligament and the interosseous membrane and courses down the back of the forearm as far as the wrist. It anastomoses with the posterior carpal of radial and ulnar and the anterior interosseous.

Branch :—

Posterior Interosseous Recurrent is given off near the origin of the posterior interosseous and passes under the anconeus to the interval between the olecranon and external condyle, anastomosing with the superior profunda anastomotic magna.

PLATE VII

The Anastomotic Vessels of Elbow and Wrist

(1) **The Anastomosis round the Elbow Joint.**

In the anastomosis round the elbow joint there are seven vessels which take part in it. Three branches coming down—superior and inferior profunda and the anastomotic; and four branches passing upwards—radial recurrent, anterior and posterior ulnar recurrents, and the posterior interosseous recurrent.

For convenience they may be divided into four groups: (1) **In front of the External Condyle,** superior profunda anastomosing with radial recurrent; (2) **In front of Internal Condyle,** the anastomotic with anterior ulnar recurrent; (3) **Behind External Condyle,** the anastomotic with interosseous recurrent and superior profunda; (4) **Behind Internal Condyle,** the anastomotic with the posterior ulnar recurrent and inferior profunda.

The vessels entering into the anastomosis round the elbow are formed by branches from: (1) Brachial, (2) Ulnar and its interosseous branch, (3) Radial.

From the Brachial:—

(A) **The Superior Profunda** anastomosing with :—
  (1) The Interosseous recurrent of Ulnar.
  (2) The Anastomotica Magna of Brachial.
(B) **The Inferior Profunda** with :—
  (1) Posterior Ulnar recurrent.
  (2) Anastomotica of Brachial.
(C) **The Anastomotica Magna** with :—
  (1) Inferior Profunda of Brachial.
  (2) Anterior and Posterior Ulnar recurrent.
  (3) Superior Profunda.

From the Radial:—

The radial recurrent anastomosing with the superior profunda.

From the Ulnar:—

(A) **The Anterior Ulnar Recurrent** anastomosing with :—
  (1) Inferior Profunda.
  (2) Anastomotica Magna.
(B) **Posterior Ulnar Recurrent** with :—
  (1) Inferior Profunda.
  (2) Anastomotica.
(C) **Posterior Interosseous Recurrent of Ulnar** with :—
  (1) Superior Profunda.
  (2) Anastomotica Magna.

(2) **The Anastomosis round the Wrist:—**

The series of vessels entering into the anastomosis round the wrist are derived from the radial and ulnar arteries.

Anastomosis around Elbow Joint

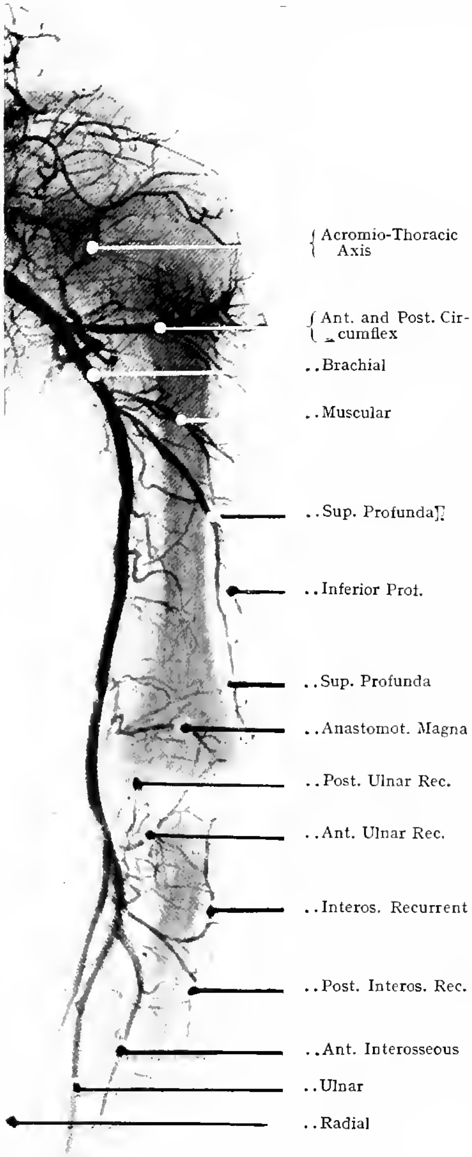
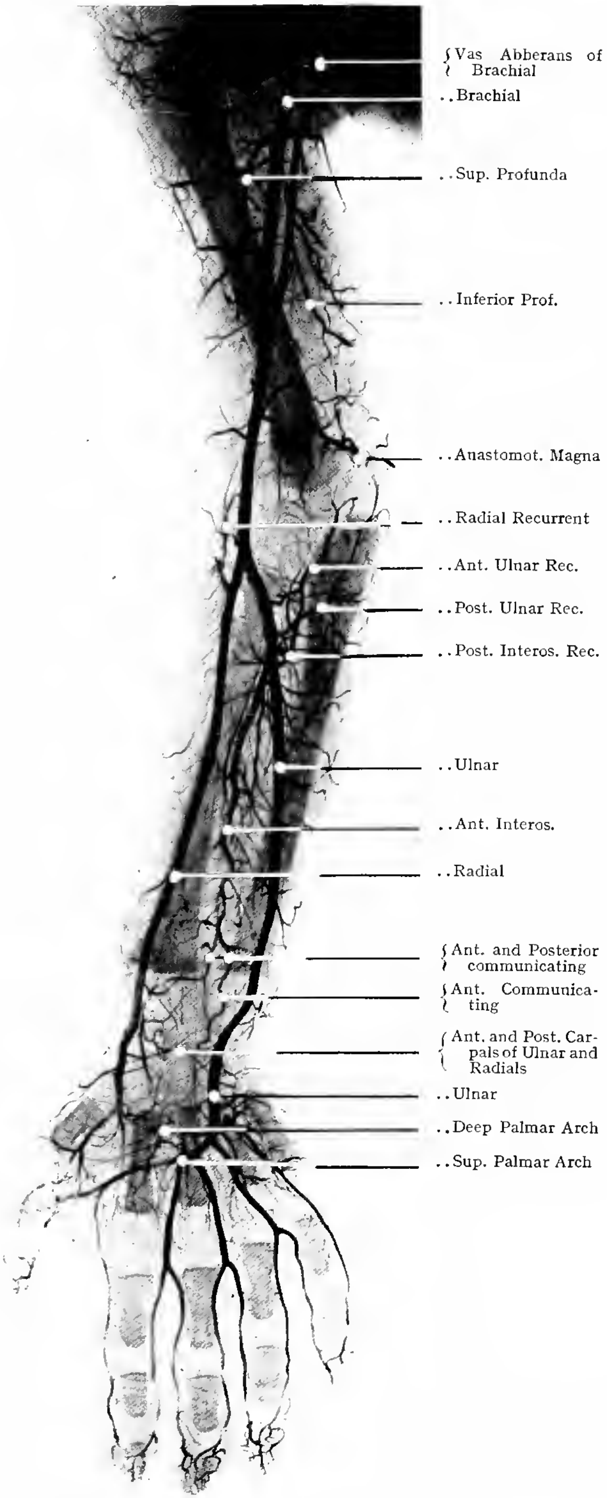


FIG. 1.—LATERAL VIEW.



ANASTOMOTIC VESSELS OF ELBOW AND WRIST.

From the Radial:—

(1) **The Superficial Vola,** which anastomoses with the ulnar, and thus completes the superficial palmar arch.

(2) **Anterior Carpal of Radial** with anterior carpal of ulnar.

(3) **Posterior Carpal of Radial** with posterior carpal of ulnar, and thereby forming the posterior carpal arch.

The posterior carpal arch anastomoses with the recurrent branches of the deep palmar arch.

From the Ulnar:—

(A) **The Anterior Interosseous branches**:—
  (1) **Anterior communicating** with :—
    (A) Anterior Carpal.
    (B) Deep Palmar Arch.
  (2) **Posterior communicating** with :—
    (A) Posterior Interosseous.
    (B) Posterior Carpals of Radial and Ulnar.

(B) **Posterior Interosseous branch** with :—
  (1) Anterior Interosseous.
  (2) Posterior Carpal of Radial and Ulnar.

(C) **Anterior Carpal of Ulnar** with anterior carpal of radial.

(D) **Posterior Carpal of Ulnar** with posterior carpal of radial and forming posterior carpal arch.

PLATE VIII

Vessels of Adult Hand

An explanatory note regarding this plate is perhaps necessary. The specimen from which this radiograph was taken was pathological—amputated as a result of injury by high explosive—thus the blemish which appears in the thenar eminence is the result of damaged vessels permitting the escape of some of the injecting fluid into the immediate surrounding tissue.

The vascular supply of the hand is derived from two sources: (1) **The Superficial,** and (2) **the Deep Palmar Arches.**

The Superficial Palmar Arch is the direct continuation of the ulnar artery. It forms an arch with the convexity downwards, and is completed on the radial side by the superficialis volæ branch of the radial artery, or probably more frequently by the radialis indicis or princeps pollicis branch of the same artery. Its position is indicated by a line drawn across the palm at the level of the lower margin of thumb abducted at right angles to the hand.

Branches: From the superficial arch are given off :—

(1) **Four digital arteries**, which supply the little finger, the ring, middle, and ulnar side of index finger. These vessels bifurcate half an inch above the clefts between the fingers.

(2) **The deep or communicating branch** is given off at the commencement of the arch, and passes downwards to complete deep palmar arch.

(3) **Recurrent** branches, which passes upwards to the annular ligament.

The Deep Palmar Arch. This is the direct continuation of the radial artery, and is completed on the ulnar side by the profunda branch of the ulnar artery. It begins at the upper end of the first interosseous space, and extends to the base of fifth metacarpal bone. It lies deeply, and rests on the palmar interossei and metacarpal bones near their carpal ends. In addition to other structures, it is covered by the superficial arch.

Its position is indicated by a line drawn parallel to that noted for the superficial arch, but a finger's breadth nearer the carpus.

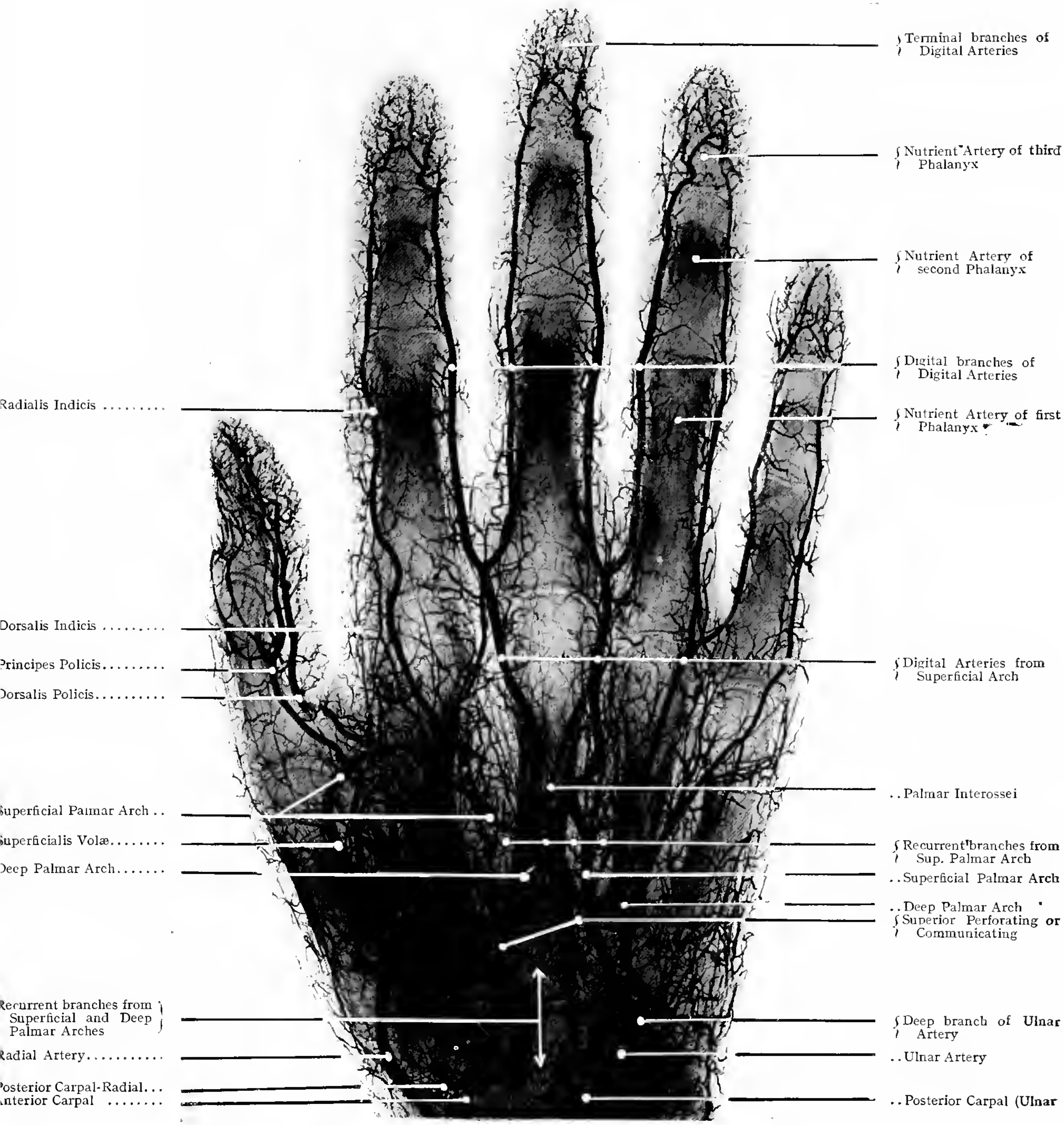
Branches of Deep Arch :—

(1) **Recurrent** branches, which ascend and anastomose with branches from the anterior carpal arch.

(2) **Superior perforating,** three in number, which pass backwards through the upper part of the last three interosseous spaces to anastomose with the dorsal interosseous arteries.

(3) **Palmar Interosseous Arteries**, three in number, which lie in front of the palmar

PLATE VIII


Terminal branches of Digital Arteries
Nutrient Artery of third Phalanyx
Nutrient Artery of second Phalanyx
Digital branches of Digital Arteries
Radialis Indicis ....
Nutrient Artery of first Phalanyx
Dorsalis Indicis ....
Principes Policis.........
Dorsalis Policis..........
Digital Arteries from Superficial Arch
..Palmar Interossei
Superficial Palmar Arch ..
Superficialis Volæ........
Recurrent branches from Sup. Palmar Arch
Deep Palmar Arch.......
..Superficial Palmar Arch
..Deep Palmar Arch
Superior Perforating or Communicating
Recurrent branches from Superficial and Deep Palmar Arches
Deep branch of Ulnar Artery
Radial Artery...........
..Ulnar Artery
Posterior Carpal-Radial...
nterior Carpal ....
..Posterior Carpal (Ulnar

VESSELS OF ADULT HAND.

interosseous muscles and anastomose at the clefts of the fingers with the digital branches from the superficial arch.

The Deep Palmar Arch. This communicates with: (1) the anterior interosseous and anterior carpal arch, (2) digital branches of the superficial arch, (3) branches of posterior carpal arch.

The Digital Vessels. In the palm the trunks of the digital arteries lie on the interosseous muscles between the metacarpal bones. They bifurcate, as will be seen from the radiograph on Plate VIII., fully half an inch above the clefts of the fingers. The most internal trunk does not bifurcate, but runs along the ulnar side of the little finger. The branches run along the sides of the fingers nearer the anterior than the posterior aspect.

PLATE IX

The Anastomosis around the Shoulder Girdle

The vessels which enter into the anastomosis around the shoulder girdle are derived from the subclavian, axillary, and brachial arteries and their branches.

From the Subclavian :—

(1) **The Supra-scapular** anastomosis with :—
  (A) Posterior Scapular.
  (B) Dorsalis Scapulæ.
  (C) Subscapular.
(2) **Posterior Scapular branch of Transverse Cervical** with :—
  (A) Supra-scapular.
  (B) Subscapular.

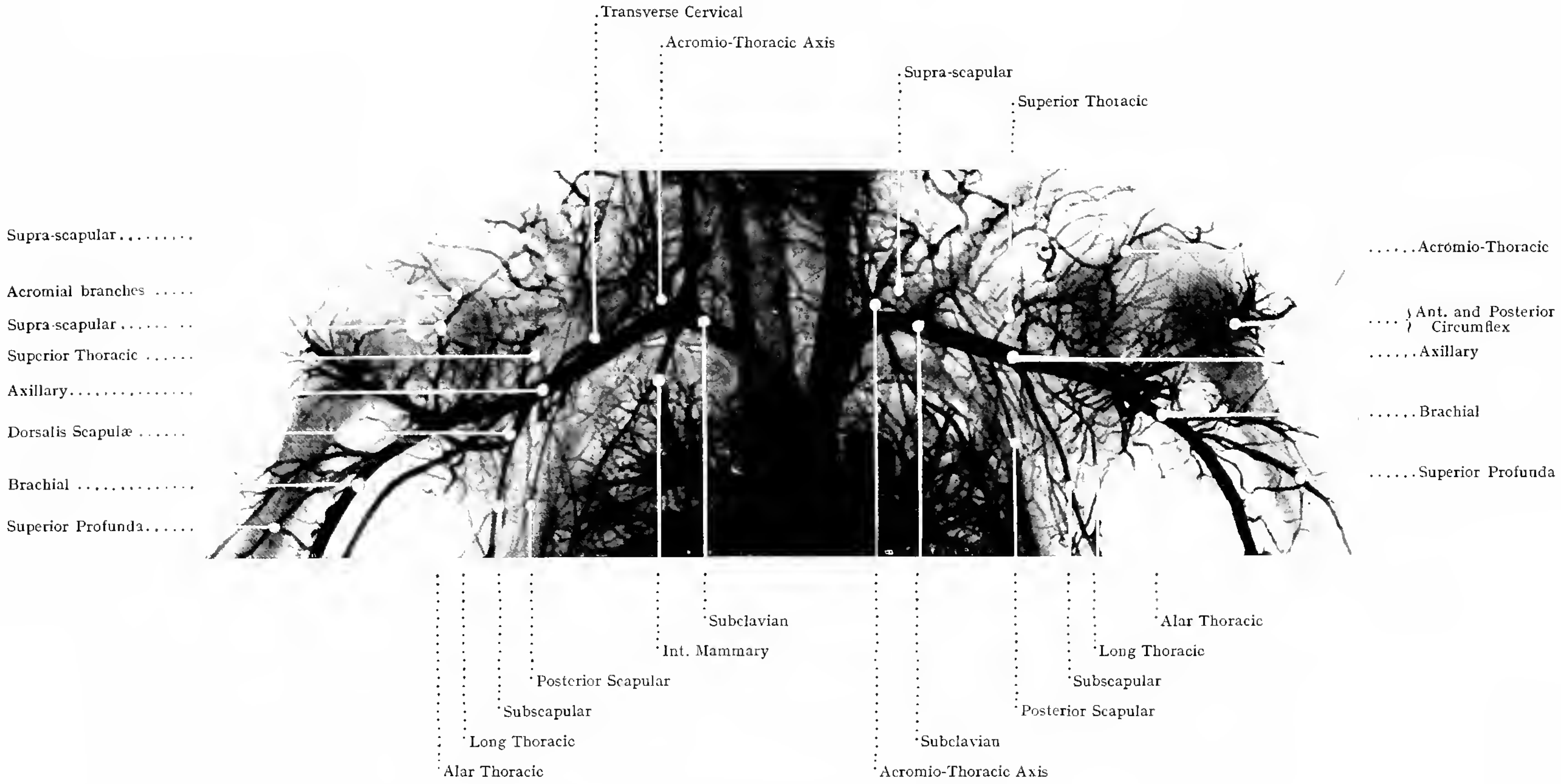
From the Axillary :—

(1) **Superior Thoracic** from first part of axillary anastomoses with :—
  (A) Internal Mammary from third part.
  (B) Intercostals.
(2) **Acromio Thoracic** with anterior and posterior circumflex.
(3) **Long Thoracic** with interostals.
(4) **Subscapular**—(Dorsalis Scapulæ branch)—with :—
  (A) Supra-scapular of third part of subclavian.
  (B) Posterior Scapular of transverse cervical of subclavian.
(5) **Anterior Circumflex** with posterior circumflex around surgical neck of humerus.
(6) **Posterior Circumflex** with anterior circumflex, and giving off :—
  (A) **An Ascending branch**, which anastomoses with acromo-thoracic branch of first part of axillary.
  (B) **A Descending branch** anastomosing with superior profunda of brachial.

From Brachial Artery :—

Superior Profunda anastomosing with posterior circumflex.

PLATE IX



ANASTOMOTIC VESSELS OF SHOULDER GIRDLE.

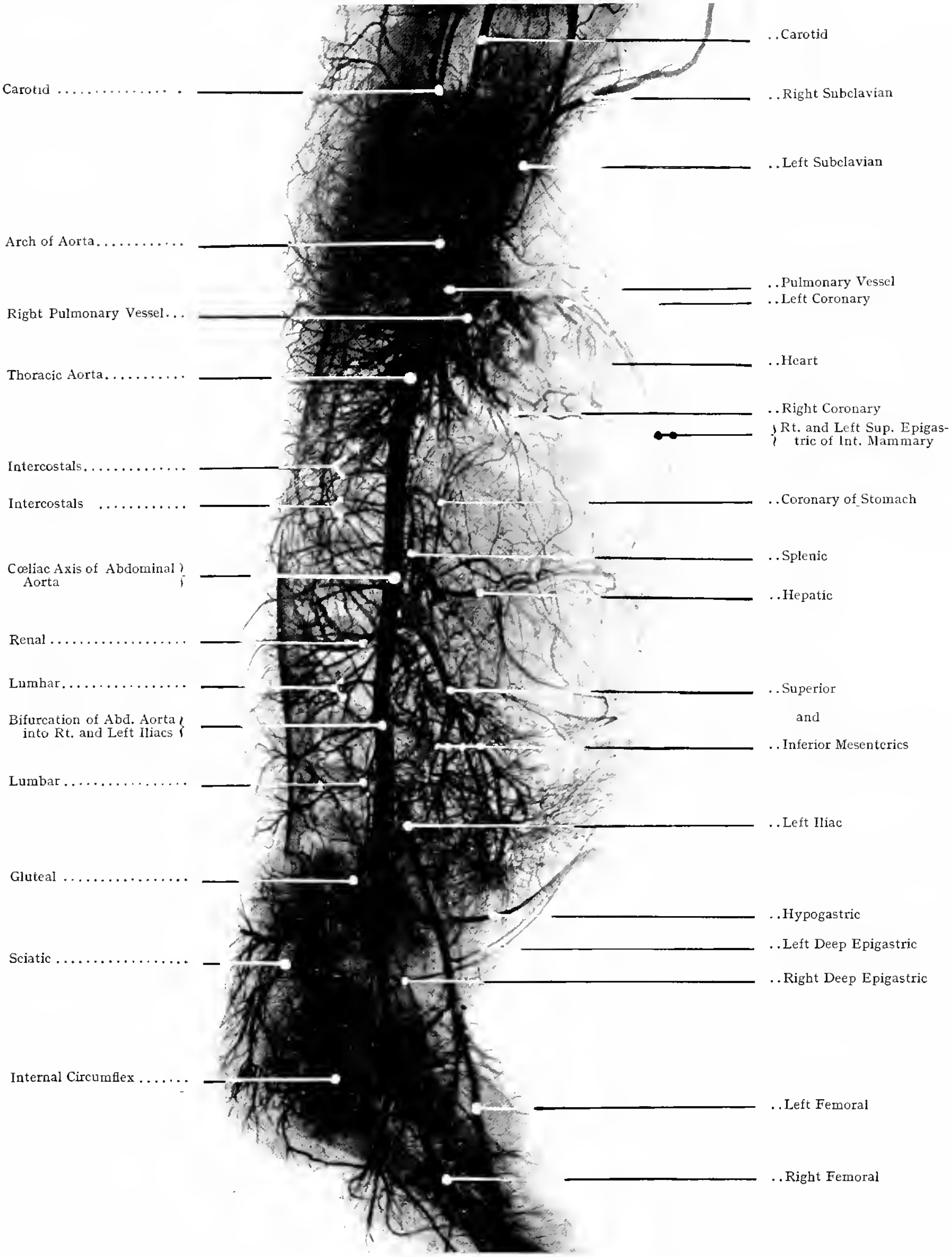
PLATE X

Lateral View of Fœtus, showing Thoracic, Abdominal, and Iliac Vessels

The radiograph shown on Plate X. has been taken in the position of the arms fully extended above the head, so as to give an unobstructed view of the lateral aspect of the thoracic and abdominal vessels of the fœtus.

The details and description of the various arteries indicated and named on this plate are referred to in their respective regional sections.

PLATE X



LATERAL VIEW OF FŒTUS, SHOWING THORACIC, ABDOMINAL, AND ILIAC VESSELS.

PLATE XI

The Vessels of the Thorax

The Descending Thoracic Aorta.

This part of the aorta is the direct continuation of the aortic arch, and extends from the lower part of the left side of the body of the fifth dorsal vertebra to the anterior aspect of the last dorsal vertebra, where it leaves the thorax by passing through the aortic opening in the diaphragm.

Its Branches are : (1) **Bronchial,** (2) **Pericardial,** (3) **Œsophageal,** (4) **Posterior Mediastinal,** (5) **Intercostal** (9 pairs).

The Intercostals (except the first and second, which arises from the subclavian : *vide* description below) are derived from the posterior part of aorta, and run transversely outwards on the bodies of the vertebræ and behind the pleura to the intercostal spaces. At these spaces they divide into anterior and posterior branches. **The anterior branch** crosses the space obliquely upwards, so as to reach the lower border of the upper rib near the angle. It anastomoses with the anterior intercostal of the internal mammary and the thoracic branches of the axillary. A branch, the collateral intercostal, is given off near the angle of the rib, and runs along the upper border of the lower rib, anastomosing with the anterior intercostal. The three lower branches pass forward between the muscles of the abdominal wall, anastomosing with the epigastric and lumbar (*vide* page 59, Plate XIII.).

The Posterior Branch passes backwards between the vertebra, sending **spinal** branches to cord, membranes, and body of vertebra ; and a muscular branch, which divide into inner and outer branches, to the muscles of the back.

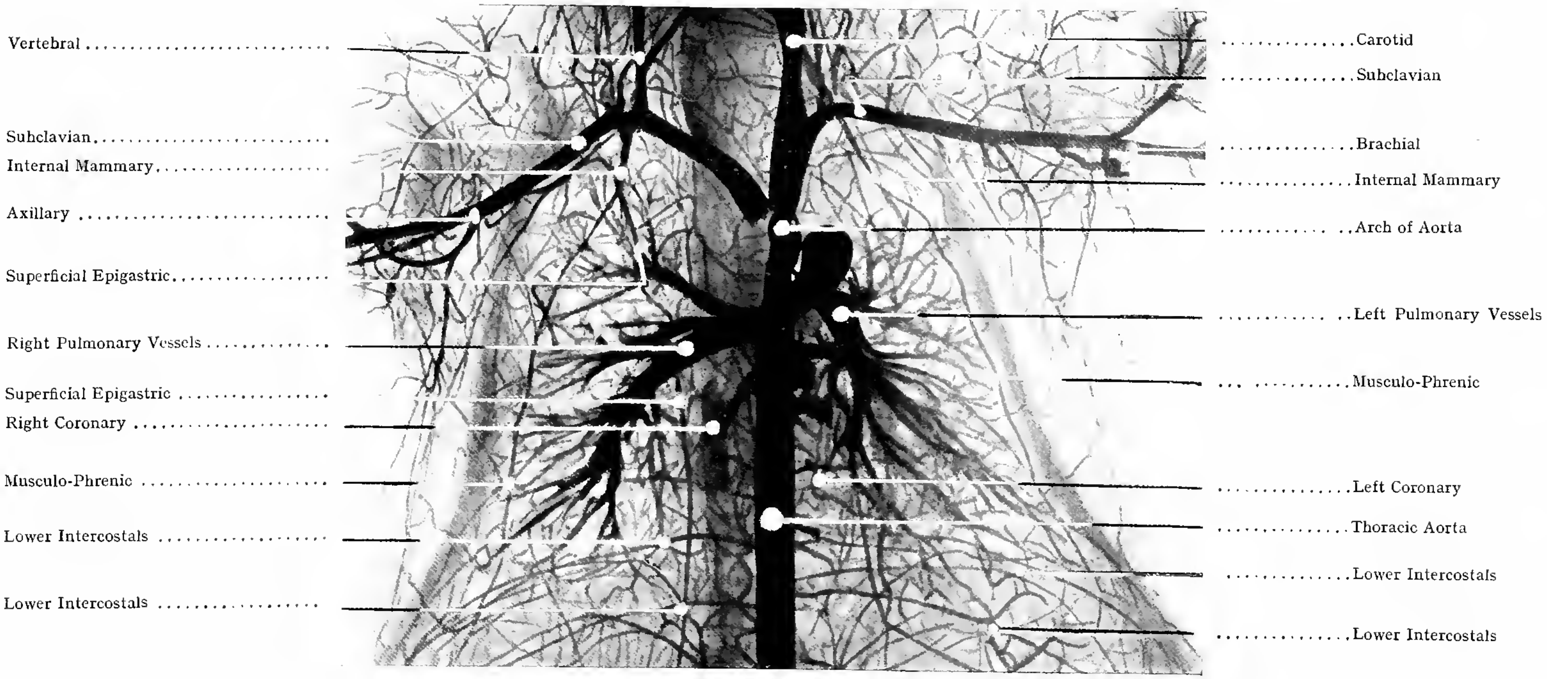
The Superior Intercostal Artery arises from the upper and posterior aspect of the second part of the subclavian. It descends into the thorax in front of the neck of the first rib, and gives off the posterior intercostal arteries to the first and second spaces, anastomosing with the first aortic intercostal and the internal mammary.

Branch : The Profunda Cervicis. This passes backwards, and corresponds to a posterior branch of an aortic intercostal. It anastomoses with the vertebral and princeps cervicis branch of the occipital artery.

The inosculation between the profunda cervicis, above mentioned, and the princeps cervicis of occipital artery is an important factor in re-establishing the circulation after ligature of the common carotid.

The Internal Mammary. This vessel arrives from the anterior and lower part of the subclavian, and passes downwards behind the clavicle at its inner end, between the first rib and the pleura. Its course lies fully half an inch external to the margin of the sternum, and in the interval between the sixth and seventh costal cartilages it ends by dividing into musculo-phrenic and superior epigastric arteries.

PLATE XI



VESSELS OF THORAX.

Branches : (1) Comes nervi phrenici (superior phrenic), (2) Mediastinal, (3) Pericardial, (4) Sternal, (5) Anterior intercostal, (6) Perforating, and (7) The two terminal branches.

Musculo-phrenic. This is the external of the two terminal branches. It passes through the diaphragm about the ninth intercostal space, supplying the diaphragm and giving branches to the lower intercostal spaces.

Superior Epigastric. This is the internal terminal branch, and passes behind the seventh costal cartilage, and piercing the diaphragm it lies posterior to the rectus within the sheath, and terminating in that muscle. It anastomoses with the deep epigastric of the external iliæ.

PLATE XII

The Heart and its Coronary Vessels

Plate XII. is reproduced from a radiograph of the heart after its removal from the thoracic cavity. The coronary vessels of the heart are two in number—right and left—and take their origin from the sinus of Valsalva.

The coronary arteries supply the substance of the heart.

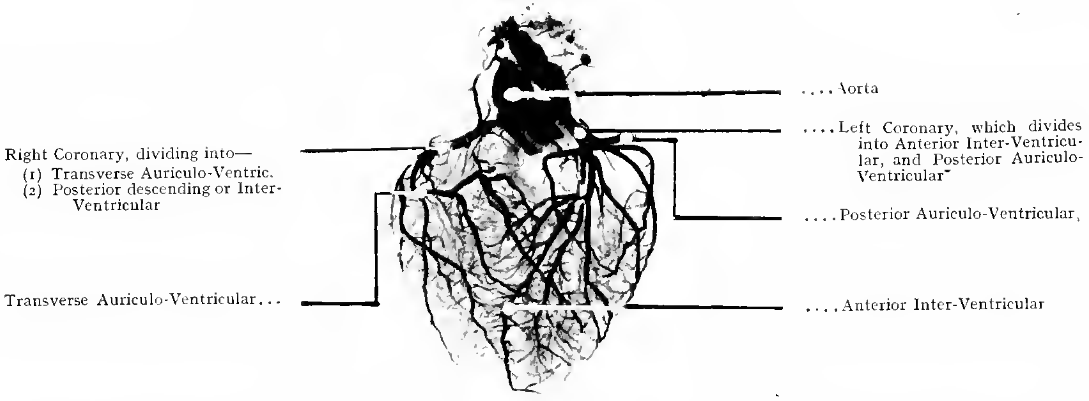
The Right Coronary Artery takes origin from the anterior sinus of Valsalva, and passes on the right side of the pulmonary artery, between it and the right appendix, it then turns backwards along the right auriculo-ventricular groove as far as the posterior inter-ventricular groove, where it divides into two branches, one of which passes transversely in the left auriculo-ventricular groove and joins the branch of the left artery, whilst the other passes downwards in the posterior inter-ventricular groove to supply the ventricles and septum, anastomosing with the descending branch of left artery.

The Left Coronary Artery arises from the left posterior sinus of Valsalva. It passes behind and then to the left of the pulmonary artery, where it divides into two branches, one of which passes forwards and downwards in the anterior inter-ventricular groove, and the other to the left and backwards along the left auriculo-ventricular groove, where it anastomoses with the descending branch of the right artery.

In the lateral view of the fœtus (Plate X.) will be seen the heart *in situ* and in its normal position and relationship with other and surrounding structures.

The posterior division of the right coronary will be detected running downwards and backwards along the posterior inter-ventricular groove, whilst the anterior division of the left coronary can be followed running upwards and forwards along the left anterior inter-ventricular groove.

PLATE XII


Right Coronary, dividing into—
(1) Transverse Auriculo-Ventric.
(2) Posterior descending or Inter-Ventricular
Transverse Auriculo-Ventricular...
....Aorta
....Left Coronary, which divides into Anterior Inter-Ventricular, and Posterior Auriculo-Ventricular
....Posterior Auriculo-Ventricular
....Anterior Inter-Ventricular

THE HEART.

Showing Coronary Vessels.

PLATE XIII

The Arteries of the Abdomen

THE ABDOMINAL AORTA AND ITS BRANCHES

The Abdominal Aorta is the direct continuation of the descending thoracic aorta, and extends from the front of the body of the last dorsal vertebra to the left side of the body of the fourth lumbar, where it bifurcates into the common iliacs a little to the left of the middle line. Its point of bifurcation corresponds very nearly to the highest part of the crest of the ilium, or nearly an inch below and half an inch to the left of the umbilicus.

Branches :—

Inferior Phrenic, right and left. These arise together just below the diaphragm and pass on to its under surface, giving off internal and external and superior capsular branches.

Cœliac Axis takes origin at a corresponding point to four or five inches above umbilicus. It is a short trunk about half an inch long, and soon divides into three visceral branches—gastric, hepatic, and splenic.

Branches :—

Coronary of Stomach is the smallest of the three branches, and passes upwards to the left to the cardiac end of the stomach, then turning to the right along the lesser curvature, giving branches on each side of the stomach, anastomosing with the pyloric branch of the hepatic.

Hepatic runs forwards and upwards to the right as far as the transverse fissure of the liver, where it divides into right and left hepatic for the supply of the corresponding lobes of the liver.

Branches : (1) Pyloric, (2) Gastro-duodenal, (3) Right gastro-epiploic, (4) Superior pancreatico-duodenal, (5) Right and left hepatic.

Splenic. This vessel is directed horizontally to the left along the superior border of the pancreas. It takes a very tortuous course, and divides into several terminal branches as it enters the hilum of the spleen.

Branches : (1) Pancreatic, (2) Left gastric-epiploic, (3) Vasa brevia gastric branches.

Supra-renal or middle capsular, arises a little below cœliac axis.

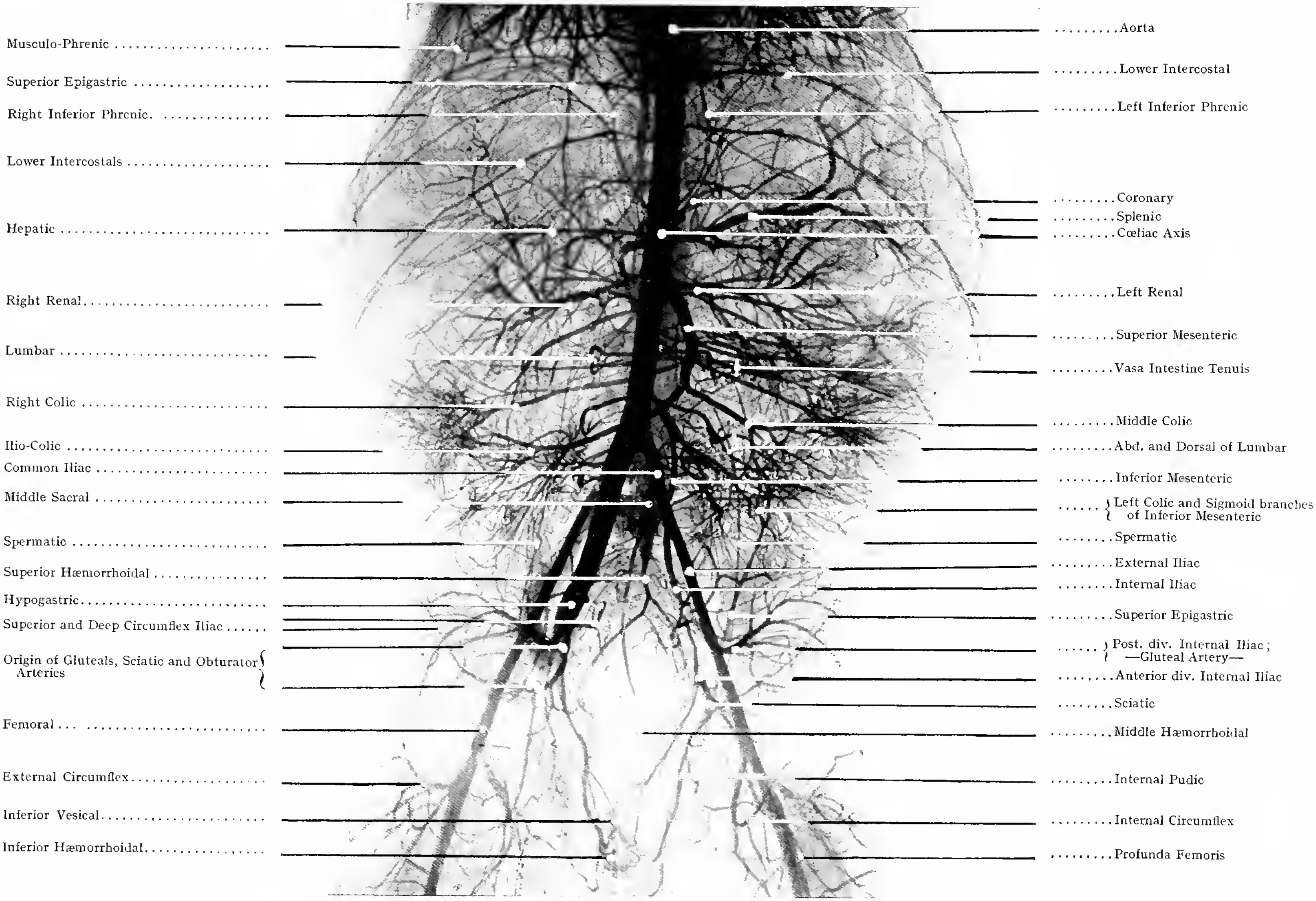
Superior Mesenteric arises about a quarter of an inch below cœliac axis, and after passing forwards and downwards and to the right between the layers of the mesentery, terminates in offsets to the small intestines, cæcum and colon.

Superior Mesenteric Branches :—

(1) Inferior pancreatico-duodenal, passing from left to right along concave border of third part of duodenum.

(2) **Vasa Intestini Tenuis,** these vessels, twelve to fifteen in number for the supply of jejunum and ileum, spring from the left convex side of the artery. At about two inches from their origin they bifurcate, each division uniting with another branch to form an arch, and from which other branches arise, these latter dividing and communicating in the same way several times (four to five), and the final branchings from which; proceeding directly to the intestine.

PLATE XIII



ABDOMINAL VESSELS.

(3) **Ileo-colic** commences at the right side of the artery and passes down to the cæcum. A descending branch passes to the lower part of ileum and an ascending to the ascending colon, anastomosing with the right colic.

(4) **Right Colic** arises from the right side of the artery and courses to the middle of the ascending colon, where its ascending branch anastomoses with the middle colic, and its descending branch with the ileo-colic.

(5) **Middle Colic.** This vessel arising from the upper part of the right side of the artery passing thence in the transverse meso-colon. It has a right and left branch. The right branch anastomoses with the right colic, whilst the left colic anastomoses with the left colic of inferior mesenteric on the descending colon.

Renal Arteries, right and left. These arise about half an inch below the superior mesenteric, the right a little lower than the left at a point which corresponds to about three and a half inches above the umbilicus. These vessels run outwards to the hilum of the kidneys. Each divides near the kidney into four or five branches before entering that viscus.

Spermatic. These are two small but very long arteries, arising just below the renal and directed downwards and outwards behind the peritoneum, crossing the external iliac artery to the internal abdominal ring. It passes along the inguinal canal and out of the external ring to the scrotum, where it divides into two branches which enter the posterior surface of the testes. It anastomoses with the artery of the vas deferens and cremasteric. In the female this artery is named the ovarian, and passes to the ovary and round ligament between the layers of the broad ligament.

Inferior Mesenteric, which arises on the left side of the aorta, about one and a half inches above the bifurcation, at a point which corresponds to about one inch above the umbilicus. It lies at first on the left side of the aorta, then crosses over the left common iliac to the back of the rectum, supply the descending, iliac and pelvic portions of the colon and rectum.

Branches :—

Left Colic is directed upwards in front of the left kidney, giving off an ascending branch, which anastomoses with the middle colic, and a descending branch, which supplies descending colon, and anastomoses with the sigmoid and superior hæmorrhoidal.

Sigmoid, which supplies the iliac and pelvic colon, anastomosing with the left colic and superior hæmorrhoidal.

Superior Hæmorrhoidal. This vessel is the continuatiom of the inferior mesenteric artery. It passes behind the rectum, dividing in the meso-rectum into two branches, which run down one on either side of the rectum to about six inches above the anus, where they subdivide to supply pelvic colon and rectum. It anastomoses with the sigmoid, middle and inferior hæmorrhoidals.

Lumbars, of which there are five pairs. They arise from the back of the aorta and pass outwards, resting on the body of the vertebra, and dividing near the transverse processes into :—

(1) **Abdominal,** which courses outwards to end between the muscles of the abdominal wall, and anastomosing with the epigastric, internal mammary, intercostals, ilio-lumbar, and the circumflex iliac.

(2) **Dorsal,** giving spinal branches to the meninges and cord, and anastomosing with the intercostal.

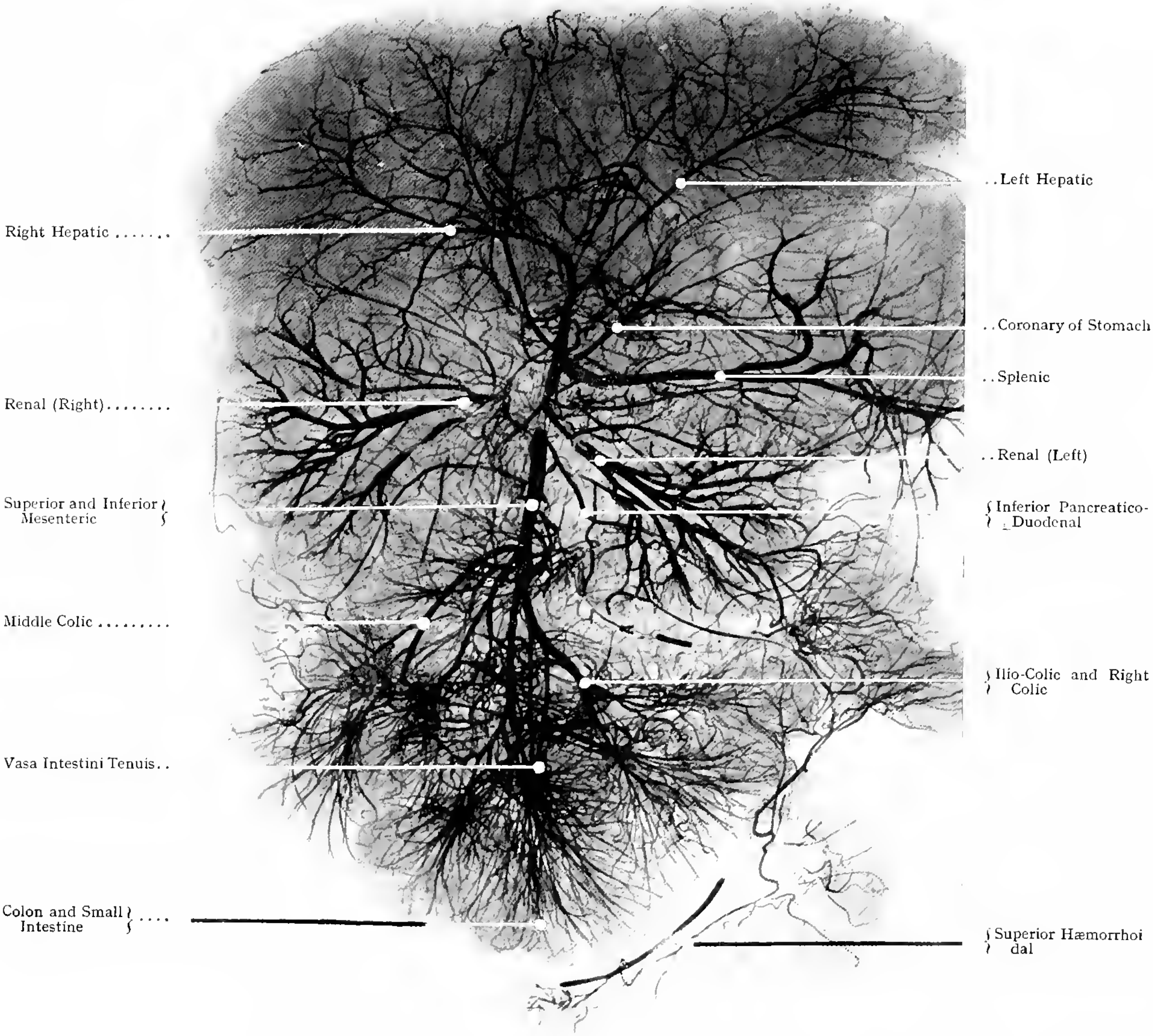
Middle Sacral. This is a small branch which is given off just at the bifurcation, runs over the fifth lumbar vertebra and centre of sacrum to the coccyx. It anastomoses with the lateral sacral.

PLATE XIV

Mesenteric and Vessels of Cœliac Axis

This plate shows the whole of the abdominal contents, together with their vascular supply, radiographed after removal *en bloc*. It thus forms a contrast aspect to the radiograph shown on Plate XIII., which view presents their position *in situ*.

PLATE XIV



Mesenteric and Vessels of the Cœliac Axis.

PLATE XV

Vessels of Lower Extremity—including Iliacs

The intention in this radiograph is to show the whole of the vascular supply of the pelvis and lower extremity in direct continuity, from its origin at the bifurcation of the abdominal aorta to its termination in the digital branches of the toes.

The Common Iliac commences at the bifurcation of the abdominal aorta at the left side of the body of the fourth lumbar vertebra, and extends to the lumbo-sacral articulation, where it divides into internal and external iliacs. Each common iliac is about two inches in length, the right being necessarily a little longer than the left, because the point of division of the abdominal aorta is slightly to the left of the median line.

The Internal Iliac extends from the bifurcation of the common iliac at the lumbo-sacral articulation to the great sacro-sciatic notch, where it divides into anterior and posterior trunks, which supply the pelvic walls and viscera. It is a short thick vessel about one and a half inches long. The internal iliac is the hypogastric artery of the fœtus, when as such it is twice as large as the external. After birth the greater part of the vessel is obliterated, a small part remaining pervious, and is known as the superior vesical. In the radiograph on Plate XV. the hypogastric is exceedingly well shown in the fullest extent of its fœtal condition.

Branches from the Anterior Trunk :—

(1) **Superior Vesical,** which supplies side and upper part of bladder.

(2) **Middle Vesical,** which supplies sides of bladder.

(3) **Inferior Vesical,** which supplies case of bladder and prostate.

(4) **Middle Hæmorrhoidal** to lower part of rectum, although sometimes this vessel may come off the inferior vesical.

(5) In the female there are two additional arteries, the uterine and the vaginal.

(6) **The Obturator,** which runs along the lateral pelvic wall to the upper part of the thyroid foramen, where it leaves the pelvis, dividing into internal and external branches, which skirt the side of the thyroid foramen and anastomose with each other and with a branch of the internal circumflex.

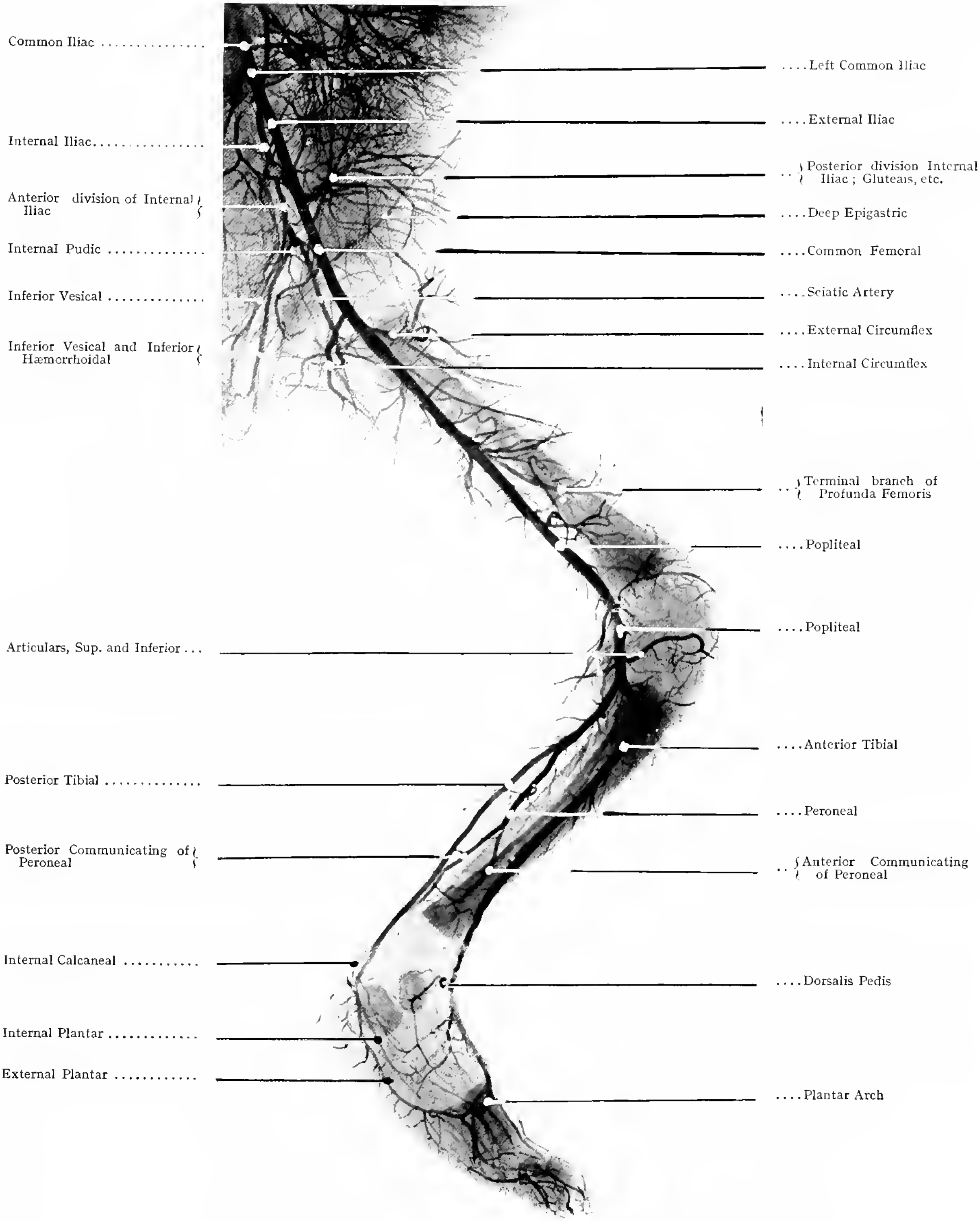
(7) **Internal Pudic** proceeds out of the pelvis by the great sacro-sciatic notch, winds round ischial spine, re-enters pelvis by the small notch, and courses along the pubic arch, dividing into dorsal artery of the penis and artery of the corpus cavernosum.

Branches :—

(1) Inferior Hæmorrhoidal.
(2) Superficial Perineal.
(3) Transverse Perineal.
(4) Artery of the Bulb.
(5) Artery of Corpus Cavernosum.
(6) Dorsal Artery of Penis.

(8) **The Sciatic** is perhaps the largest branch of the internal iliac, passes out through the lower part of the great sacro-sciatic foramen with the internal pudic artery, and lies

PLATE XV



VESSELS OF LOWER EXTREMITY—INCLUDING ILIACS.

outside the pelvis between the tuber ischii and the great trochanter under the gluteus maximus, ending in cutaneous branches to the thigh.

Branches : (1) **Coccygeal,** (2) **Muscular,** (3) **Articular** to hip joint, (4) **Comes Nervi Ischiadici,** which accompanies great sciatic nerve, (5) **Anastomotic,** which passes to the pit of the great trochanter and enters into the digital anastomosis. It also supply the external rotators. It anastomoses with the gluteal and the ascending branch of the internal iliac. The anastomotic also sends branches to the crucial anastomosis, anastomosing with first perforating and internal and external circumflex.

Branches from Posterior Trunk :—

(1) **Gluteal.** This is the largest branch of the internal iliac, and passes out of the pelvis, dividing into superficial and deep branches.

The Superficial Branch supplies the gluteus maximus after passing between the two larger glutei ; it anastomoses with the sciatic and internal circumflex.

The Deep Branch passes between the two smaller glutei and subdivides into :—

Superior Division to the anterior superior iliac spine, anastomosing with the circumflex iliac and ascending branch of external circumflex.

Inferior Division, which supplies gluteal muscles and descends to great trochanter, anastomosing with the external circumflex.

(2) **Nutrient** branch to hip joint.

(3) **Ilio-lumbar** to iliac fossa, dividing into ascending or lumbar, and a transverse or iliac to iliacus muscle and bone, anastomosing with lumbar and deep circumflex iliac.

(4) Lateral Sacral, **superior** to upper part of sacrum, and **inferior** to lower part.

The External Iliac. This artery extends from the bifurcation of the common iliac at the lumbo-sacral articulation to the lower border of Poupart's ligament.

Branches :—

(1) **Deep Epigastric** arises from the fore part of the external iliac about a quarter of an inch above Poupart's ligament, it then descends to the level of that ligament and curves forwards to reach the anterior aspect of the peritoneal bag ; then it passes upwards and inwards to enter the sheath of the rectus in front of the fold of Douglas, where it terminates by anastomosing with the superior epigastric branch of the internal mammary and lower intercostals.

Its branches are : Cremasteric, pubic, muscular.

(2) **Deep Circumflex Iliac** arises from the outer side of the external iliac, about the same level as the deep epigastric, and runs outwards behind Poupart's ligament to the anterior superior iliac spine, then along the crest to anastomose with the ilio-lumbar artery. It is an important collateral supply in ligature of the external iliac.

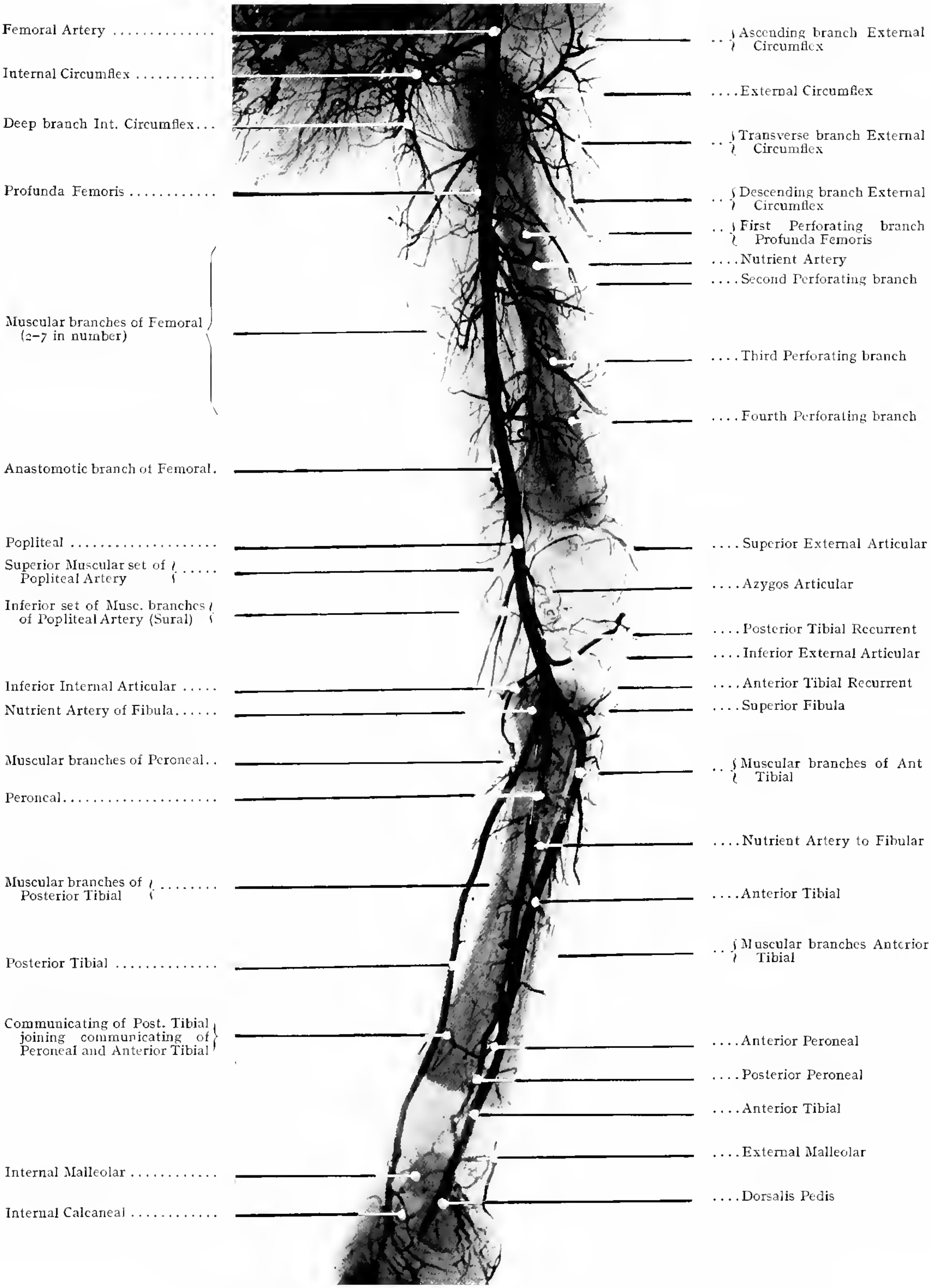
PLATE XVI

Vessels of Lower Extremity

ANTERO-POSTERIOR VIEW

This radiograph is introduced in the series of plates of the lower extremity, to show the vessels from an antero-posterior aspect, and as a contrast to that of the lateral view. For a description of the vessels, reference is made to pages 72, 75, 76 and 77

PLATE XVI


Femoral Artery
Internal Circumflex
Deep branch Int. Circumflex
Profunda Femoris
Muscular branches of Femoral (2–7 in number)
Anastomotic branch of Femoral.
Popliteal
Superior Muscular set of Popliteal Artery
Inferior set of Musc. branches of Popliteal Artery (Sural)
Inferior Internal Articular
Nutrient Artery of Fibula
Muscular branches of Peroneal
Peroneal
Muscular branches of Posterior Tibial
Posterior Tibial
Communicating of Post. Tibial joining communicating of Peroneal and Anterior Tibial
Internal Malleolar
Internal Calcaneal
Ascending branch External Circumflex
External Circumflex
Transverse branch External Circumflex
Descending branch External Circumflex
First Perforating branch Profunda Femoris
Nutrient Artery
Second Perforating branch
Third Perforating branch
Fourth Perforating branch
Superior External Articular
Azygos Articular
Posterior Tibial Recurrent
Inferior External Articular
Anterior Tibial Recurrent
Superior Fibula
Muscular branches of Ant Tibial
Nutrient Artery to Fibular
Anterior Tibial
Muscular branches Anterior Tibial
Anterior Peroneal
Posterior Peroneal
Anterior Tibial
External Malleolar
Dorsalis Pedis

Vessels of Lower Extremity (Antero-Posterior View).

PLATE XVII

Vessels of Lower Extremity (Lateral View)

This plate shows the vessels of the lower extremity, viz. femorals, anterior and posterior tibial arteries and their branches; from a lateral aspect.

The Femoral Artery is the direct continuation of the external iliac, and extends from **Poupart's** ligament to the opening in the adductor magnus, and corresponds to the upper two-thirds of the thigh. The artery at first lies immediately over the head of the femur, but as it passes downwards it takes an oblique course along the inner side of the bone, and finally passes behind it as it enters the popliteal space, through the opening in the adductor magnus. It should be noted that the "common femoral" of surgeons is the femoral artery before it has given off its profunda branch ("deep femoral"). It is usually about one and a half inches in length. Below this point it is known as the "superficial femoral."

Branches :—

Superficial Epigastric arises about half an inch below Poupart's ligament, and ascends through the saphenous opening to the abdominal wall as high as the umbilicus in the fascia, anastomosing with its fellow of the opposite side and the superficial branches of the deep epigastric.

Superficial Circumflex Iliac arises near superficial epigastric, and courses outwards to iliac crest, anastomosing with deep circumflex iliac, gluteal, and external circumflex arteries.

Superior External Pudic arises from inner side of artery half an inch below Poupart's ligament, pierces cribriform fascia of saphenous opening and runs upwards to pubic spine, crossing the external ring and spermatic cord, and anastomosing with internal pudic.

Deep External Pudic arises separately or from a common trunk with superior external pudic; supplies scrotum or labium, and anastomoses with superficial perineal.

The Deep Femoral—profunda femoris. This vessel arises from the outer and posterior part of the femoral artery about one and a half inches from its commencement. At first it passes downwards and outwards, then curves inwards behind the femoral artery and the adductor longus muscle, which latter separates the two vessels; and passing downwards, terminates by piercing the adductor longus.

Branches :—

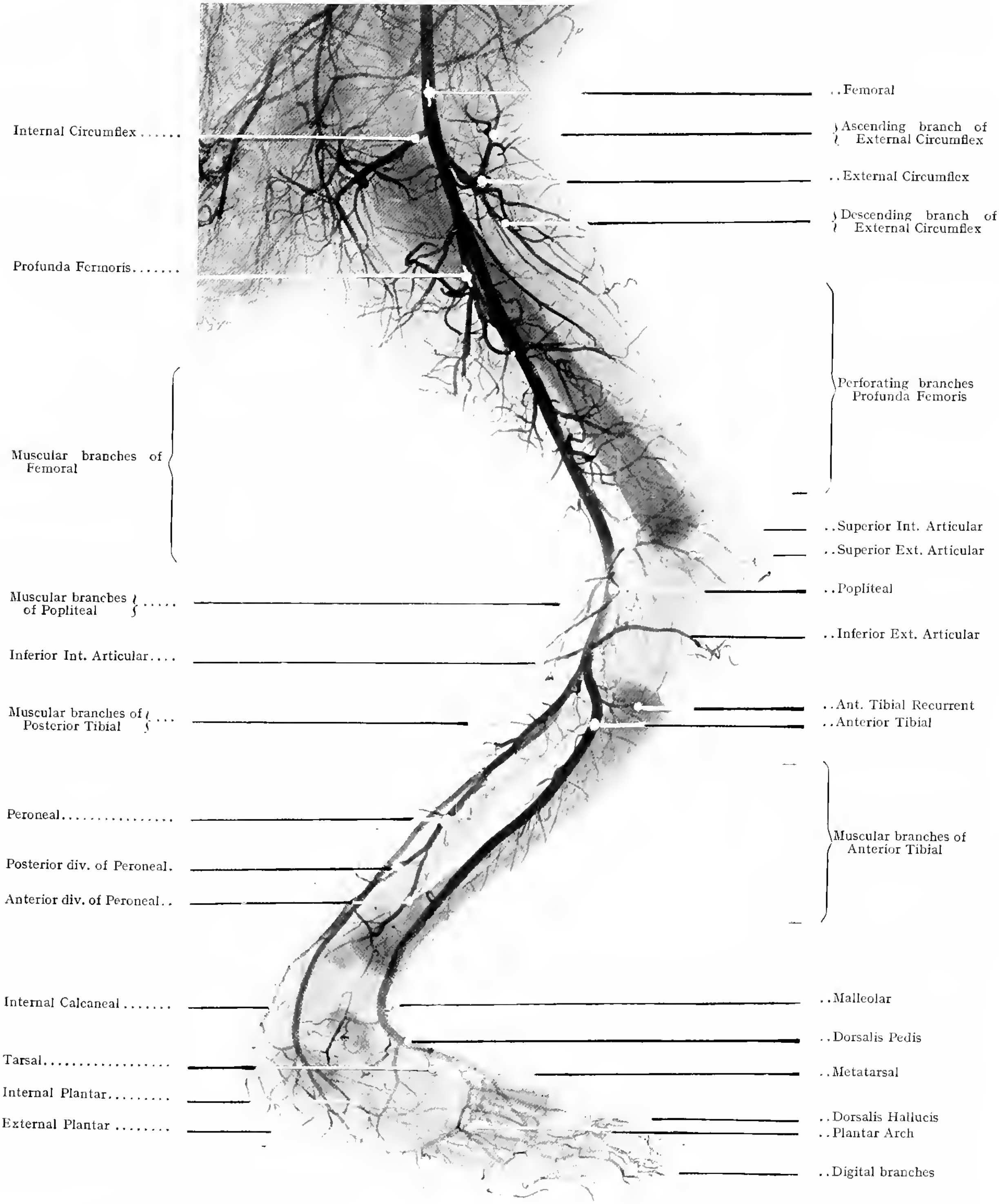
External Circumflex arises about two inches below Poupart's ligament, passes outwards beneath sartorius and rectus, and divides into :—

(1) **Ascending Branches,** which passes upwards and anastomose with the gluteal and circumflex iliac arteries.

(2) **Transverse,** which passes outwards, piercing crureus and vastus externus, anastomosing on the back of the thigh with the internal circumflex, gluteal, sciatic and superior perforating arteries (crucial anastomosis).

(3) **Descending Branches,** which pass **downwards** towards the knee, and anastomose with the superior articular branches of popliteal.

PLATE XVII



Lower Extremity (Lateral View).

The Internal Circumflex. This vessel also arises about two inches below Poupart's ligament, from the inner and back part of the artery, passing directly backwards towards the gluteal region, and there anastomosing with the gluteal, sciatic, and superior perforating arteries. It gives a small branch to the hip joint. As it reaches the small trochanter in its passage backwards it divides into two branches, one ascending to the digital fossa of the great trochanter, the other to the hamstrings, giving off muscular branches, which divide into superficial and deep branches to upper adductor muscles; the trunk of the artery passes outwards and backwards, anastomosing with first perforating, sciatic, and external circumflex, forming the crucial anastomosis.

Perforating Branches. These have been described on page 78 (*vide* Plate XVIII.).

Muscular Branches, two to seven in number, supplying sartorius and vastus internus.

Anastomotic Branch is given off in the lower part of Hunter's canal, and arises just before the femoral passes through the opening. It courses in the line of the femoral to the internal condyle. It divides into superficial and deep branches—the **superficial** accompanies the long saphaneous nerve, anastomosing with the inferior internal articular, while the deep descends to the inner side of knee, giving off an **external** branch, which crosses the femur, supplying branches to the knee-joint, anastomosing with the superior external articular, forming an arch above the patella.

POPLITEAL ARTERY (Plates XVI. and XVII.)

The Popliteal Artery is the direct continuation of the femoral. It extends from the opening in the adductor magnus to the lower border of the popliteus muscle, where it divides into anterior and posterior tibials. Its point of division corresponds to the lower part of the tubercle of the tibia in the front. It passes obliquely from the inner side of the femur to the middle of the popliteal space exactly behind the knee joint, and is then directed straight downwards.

Branches :—

Muscular, Superior Set, to lower end of hamstrings, anastomosing with the perforating of the profunda and the superior articular.

Inferior Set, or Sural, which arises from the posterior part of the artery opposite the knee joint, supplying both heads of gastrocnemis plantaris and soleus.

Superficial, which accompanies external saphenous nerve to the skin.

Articular Branches, five in number—two superior, two inferior, and an azygos.

(1) **Superior Articular, Internal.** Arises just above condyles of femur, courses transversely inwards to front of knee, and anastomosing with superior external articular and anastomostic.

External, winds beneath biceps, supplying joint by superficial and deep branches. Anastomoses with the descending branch of external circumflex, external division of anostomotic, and superior internal articular, forming an arch; also with inferior external articular.

(2) **Inferior Articular, Internal.** Passes down on internal tuberosity of tibia beneath gastrocnemeus and internal lateral ligament, anastomosing with the opposite artery, superior internal articular, and the anterior tibial recurrent.

External, courses outwards under outer head of gastrocnemeus and external lateral ligament, anastomosing in front with other articular branches and the anterior tibial recurrent.

Azygos Articular arises opposite flexure of joint, pierces posterior ligament, supplies crucial ligaments and other structures in the joint.

ANTERIOR AND POSTERIOR TIBIALS AND PERONEAL

(Plates XV., XVI., and XVII.)

The Anterior Tibial extends from the bifurcation of the popliteal artery at the lower border of the popliteus muscle to the middle of the ankle joint, where it becomes the dorsal artery of the foot. Its course is directed forwards between the two heads of the tibialis posticus to reach the anterior surface of the interosseous membrane, it then passes downwards obliquely towards the ankle joint. In its upper two thirds the vessel lies deeply, but in its lower thirds it is more superficial. Its course may be indicated by a line drawn from the inner side of the head of the fibula to a point midway between the internal and external malleoli.

Branches :—

Posterior Tibial Recurrent, passes upwards deep to popliteus muscle to the back of knee. It is well to note that this vessel is not always present.

Superior Fibular winds round to the back of the fibula over the neck through the soleus to the peroneus longus.

Anterior Tibial Recurrent. This vessel arises as the artery reaches the anterior surface of the interosseous membrane, and passes in the substance of the tibialis anticus to the external and anterior surfaces of the knee joint, anastomosing with the articular of the popliteal.

Malleolar—Internal and **External.** These arise immediately above the ankle joint, supplying it.

Internal, passes beneath extensor longus hallucis and tendon of tibialis anticus to inner malleolus, anastomosing with branches of the posterior tibial.

External. This branch is larger than the internal, and passes outwards beneath extensor longus digitorum and peroneus tertius, and anastomoses with the anterior peroneal artery and the tarsal branch of the dorsalis pedis.

Muscular, branches to surrounding muscles.

POSTERIOR TIBIAL AND PERONEAL (Plates XVI. and XVII.)

The Posterior Tibial Artery extends from the bifurcation of the popliteal at the lower border of the popliteus muscle, to the inner side of the os calcis, where it ends by dividing into the internal and the external plantar arteries beneath the internal annular ligament, and at about half an inch behind and below the internal malleolus. It lies between the surficial and deep muscles of the calf. Its course is roughly indicated by a line drawn from a point one inch below the middle of the popliteal space and in the middle line of the limb, to a point a finger's breadth behind the internal malleolus, or to a point midway between the tip of the malleolus and the convexity of the heel.

Branches :—

The Peroneal Artery. This artery may replace the posterior tibial. It is often as large as, or even larger than, the posterior tibial artery, and arises from that vessel about one inch to one and a half inches from its origin. At first it passes obliquely outwards towards the fibula, then behind and downwards, quite close to the bone, until about two inches above the ankle, where it divides into its terminal branches. It first lies on the tibialis posticus, and then passes into the substance of the flexor longus hallucis, in which it lies for the rest of its extent, when at the lower part of the interosseous membrane it gives off the anterior peroneal; and is continued on as the posterior peroneal, which passes down to the external malleolus, and anastomoses with the external malleolar, external plantar and tarsal arteries.

The Branches of the Peroneal: (1) **Muscular;** (2) **Nutrient,** to the fibula, passing in a downward direction; (3) **Communicating,** to join communicating of posterior tibial; (4) **Anterior Peroneal,** given off about two inches above the ankle, pierces the interosseous membrane and passes down in front of the fibula to the outer ankle, and there anastomoses with the external malleolar of the anterior tibial, tarsal branches of the dorsalis pedis, and the posterior peroneal.

Muscular, to soleus and deep muscles of back of leg.

Nutrient, to the tibia, the largest nutrient branch in the body, arises near the origin of the posterior tibial, and passes downwards to the bone.

Communicating, arises two inches above inner malleolus, courses beneath flexor longus hallucis, anastomosing with communicating of peroneal.

Internal Calcaneal, arises near termination of posterior tibial, pierces the internal annular ligament, to supply skin, fat of heel, and muscles on inner side of foot. It is an important vessel, as being the chief artery supplying the heel flap in Syme's amputation.

PLATE XVIII

The Perforating Arteries of Profunda Femoris

The Perforating Arteries of the profunda femoris are four in number, and pass backward through the protecting aponeurotic arches close to the femur, perforating the adductor magnus, and appearing on the posterior surface of that muscle. These arteries form a regular chain of anastomosis in the back of the thigh ; connected above with the gluteal and sciatic arteries, and below with the anastomotica magna and superior articular branch of the popliteal.

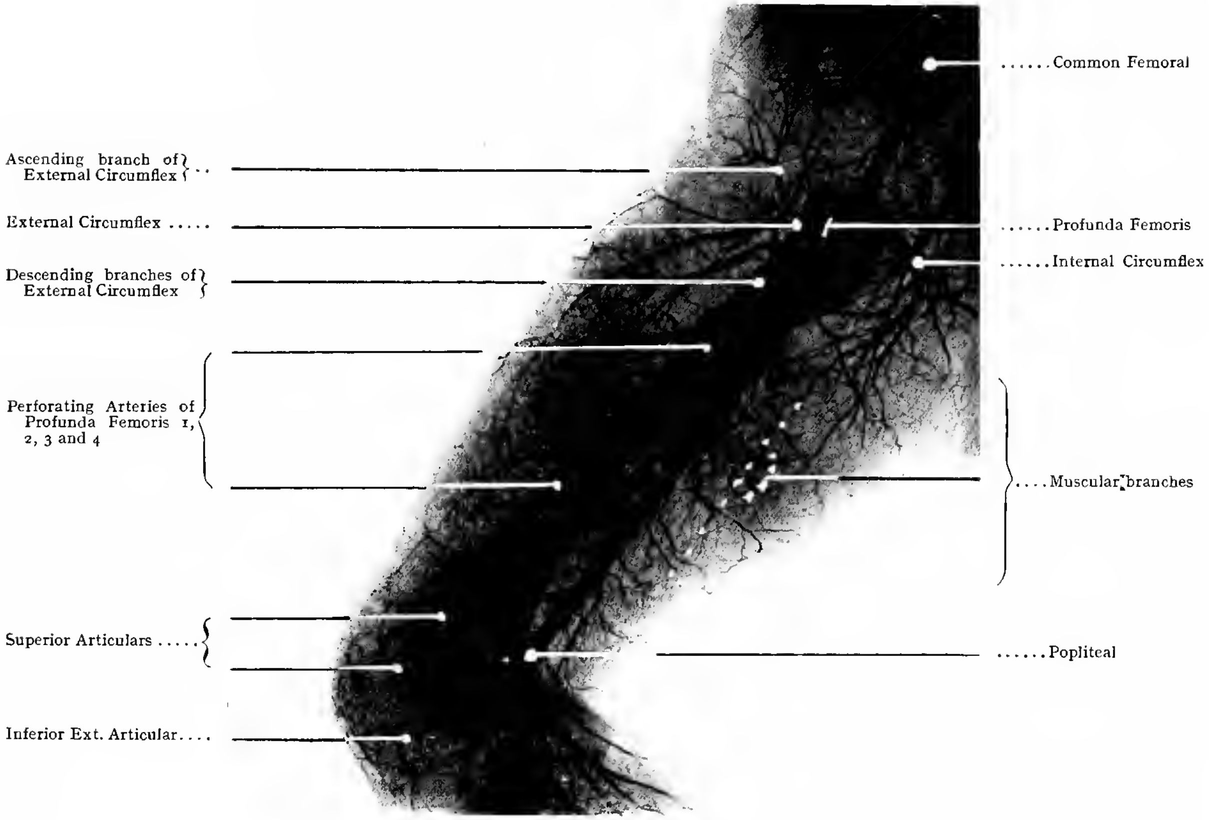
First Perforating commences opposite the lower border of the pectineus, and perforates the adductores brevis and magnus, and is distributed to the biceps and gluteus maximus, anastomosing with the sciatic, internal, and external circumflex arteries.

Second Perforating comes off near the middle of the adductor brevis, perforating it and the magnus and supplying the hamstrings. It is from the second perforating that the nutrient artery to the femur is given off.

Third arises at the lower border of the adductor brevis, perforating the magnus and ending in the biceps.

Fourth is the terminal branch of the profunda femoris, and pierces the adductor magnus near the opening for the femoral vessels. It anastomoses with the popliteal and lower perforating.

PLATE XVIII



LATERAL VIEW OF FEMORAL ARTERY.

Showing Perforating Branches

PLATE XIX

The Foot

Figs. 1 and 2

Fig. 1 shows the vessels of the foot radiographed from a dorso-plantar aspect.

Fig. 2, radiographed from a marked inverted position of the foot, gives an alternative aspect of the same vessels, but with a somewhat extended field.

The vascular supply of the foot is derived from the terminal portions of the anterior and posterior tibial arteries, together with their branches, viz. dorsalis pedis, internal and external plantars.

The Dorsal Artery of the Foot commences at the bend of the ankle and extends to the posterior end of the first interosseous space, where it ends by anastomosing with the external plantar artery to form the plantar arch after it has entered the sole of the foot through the first dorsal interosseous muscle.

Branches :—

(1) **Tarsal.** This branch arises opposite the head of the astragalus, crossing the navicular and coursing forwards and outwards and then backwards. It anastomoses with the external plantar, metatarsal, external malleolar, and anterior peroneal arteries.

(2) **Metatarsal** is given off close to the bases of the metatarsals, and passes in an arched direction to the outer side of the foot. It anastomoses with the tarsal and external plantar arteries.

From the convexity of the arch arises three arteries—the dorsal interosseous branches to the three outer interosseous spaces ; at the cleft of the toes they divide, forming the digital branches. Each of the interosseous arteries communicates at their point of bifurcation with the **plantar digitals** by an **anterior perforating** branch ; whilst at the posterior end of the interosseous space with the **plantar arch** by the posterior perforating branch.

The First Dorsal Interosseous Artery makes its appearance just as the dorsalis pedis is about to enter the sole. It lies on the dorsal aspect of first interosseous space, dividing at the cleft of the toes, to supply the contiguous sides of first and second toes and a branch to inner side of first toe.

Ateria Magna Hallucis or plantar digital, takes origin in the sole of the foot, passing forward in the first interosseous space to the cleft of first and second toes, where it divides into two branches for their supply, and giving off a branch to inner side of great toe.

The Internal Plantar. This artery is the smaller of the two terminal branches of the posterior tibial. It commences at about midway between internal malleolus and the heel, from which point it is directed forwards along the inner side of the foot to the base of the first metatarsal bone, and thence to the inner side of great toe, anastomosing with the inner digital branch.

PLATE XIX

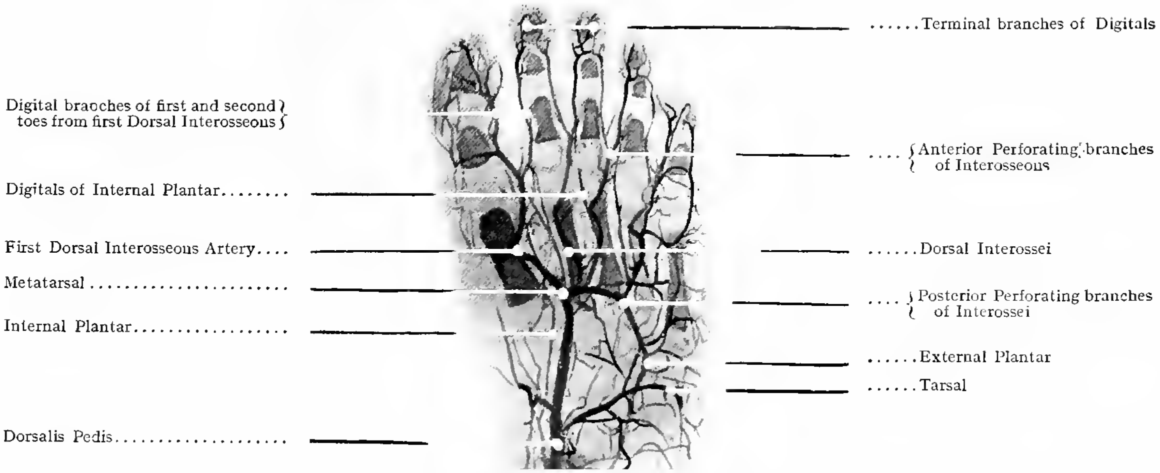

Digital branches of first and second toes from first Dorsal Interosseous
Digitals of Internal Plantar
First Dorsal Interosseous Artery
Metatarsal
Internal Plantar
Dorsalis Pedis
Terminal branches of Digitals
Anterior Perforating branches of Interosseous
Dorsal Interossei
Posterior Perforating branches of Interossei
External Plantar
Tarsal

FIG. 1.—DORSO-PLANTAR VIEW.

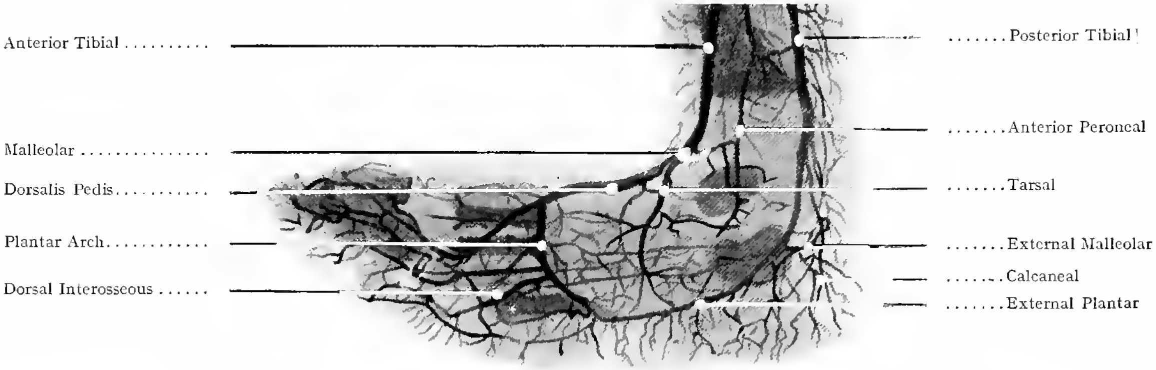


FIG. 2.—LATERAL VIEW.

The Foot.

The only important surgical branches of the internal plantar are **digital** to the clefts of the second, third, fourth, and fifth toes. These join the digital branches from the plantar arch.

External Plantar Artery is the larger of the two terminals of the posterior tibial, and commences nearer the malleolus than the heel, at the bifurcation of the posterior tibial. It passes from the inner part of the foot forwards and outwards, taking a slightly arched course, with the convexity outwards, to the base of the fifth metatarsal, thence forwards and inwards to the posterior part of first interosseous space where, anastomosing with the dorsalis pedis, it completes the plantar arch.

The plantar arch is found lying upon the interossei and across the tarsal end of the metatarsal bones.

Branches from Plantar Arch :—

Recurrent. These are small branches which pass backward to the tarsal joints, and anastomoses with branches from internal plantar.

Posterior Perforating. Three in number, which ascend to dorsum of foot through the posterior part of the three outer interosseous spaces. These anastomose with the interossei of the metatarsal.

Digital. Of which there are four. These supply both sides of the three outer toes and the outer half of the second, bifurcating at the cleft of the toes, and giving off at their point of division an anterior perforating branch, which anastomoses with the interosseous arteries of the dorsalis pedis.

STEREOSCOPIC RADIOGRAPHS

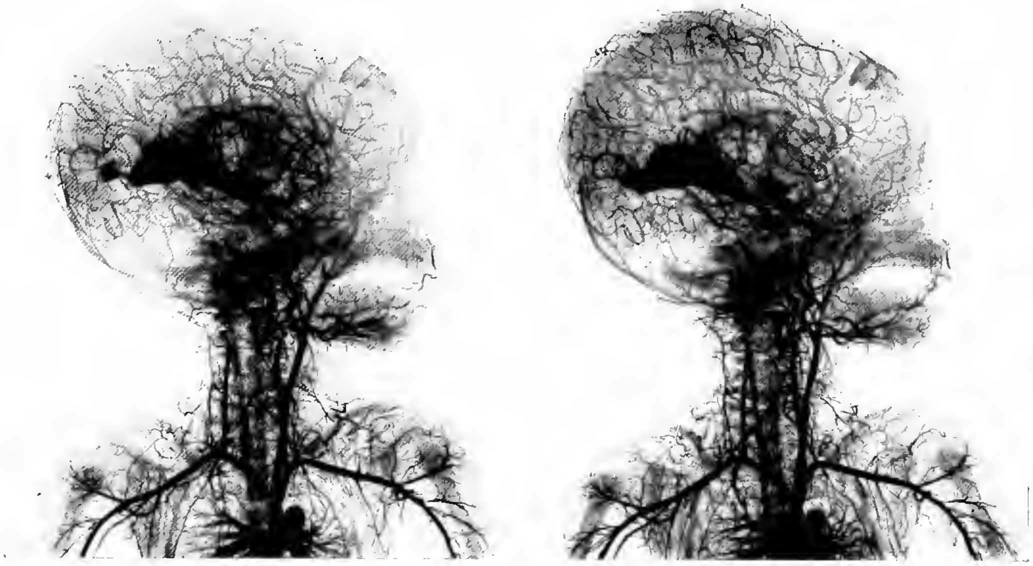
Plates XX. and XXI.

On pages 87 and 89 will be found a series of six stereoscopic plates of the anatomical regions already illustrated. If these be removed along the lines of perforation and mounted on card the exact size, they can then be used in any ordinary hand stereoscope. The enhanced beauty of the effect thus obtained will at once be apparent. These stereoscopic radiographs should be an invaluable help in the study of anatomy.

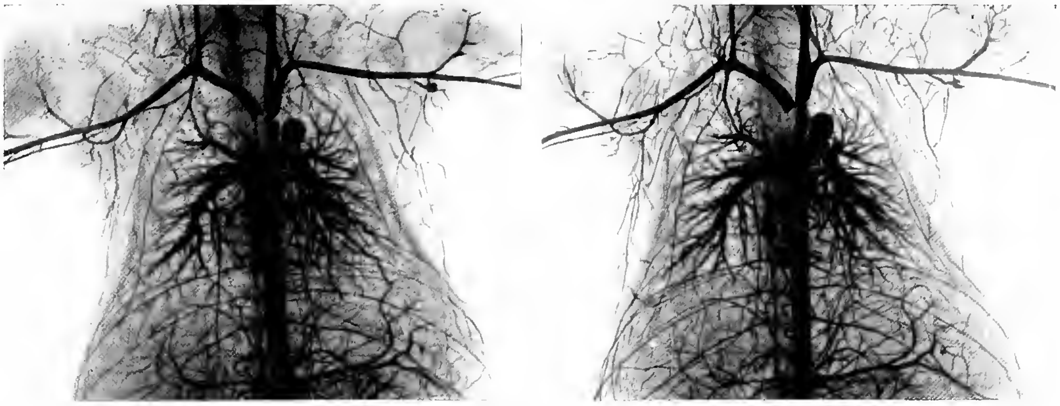
PLATE XX

STEREOSCOPIC RADIOGRAPHS OF HEAD AND NECK, THORAX, AND ABDOMEN

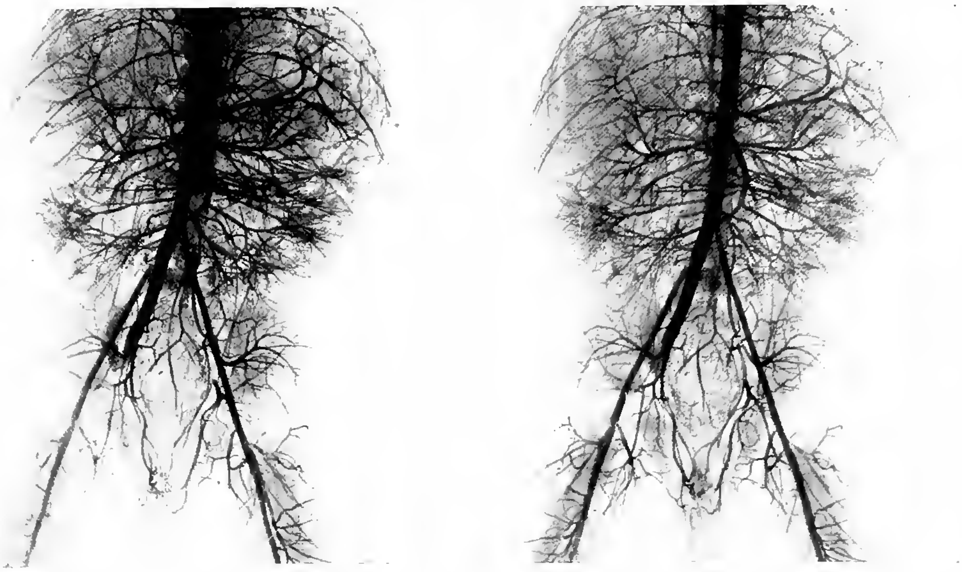
HEAD AND NECK.



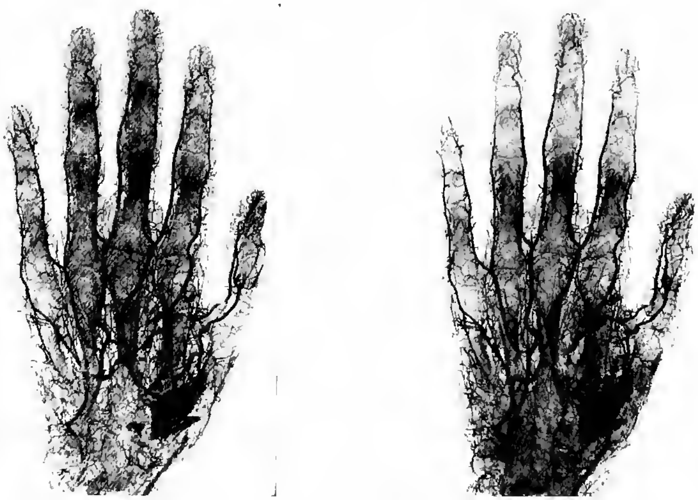
THORAX.



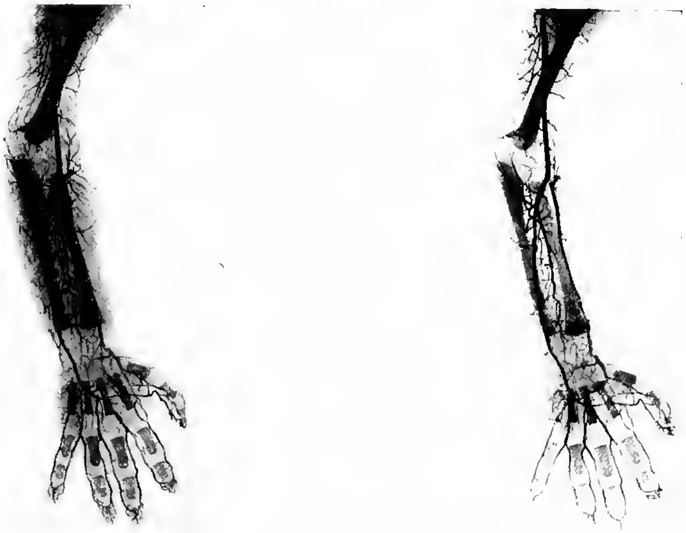
ABDOMEN.



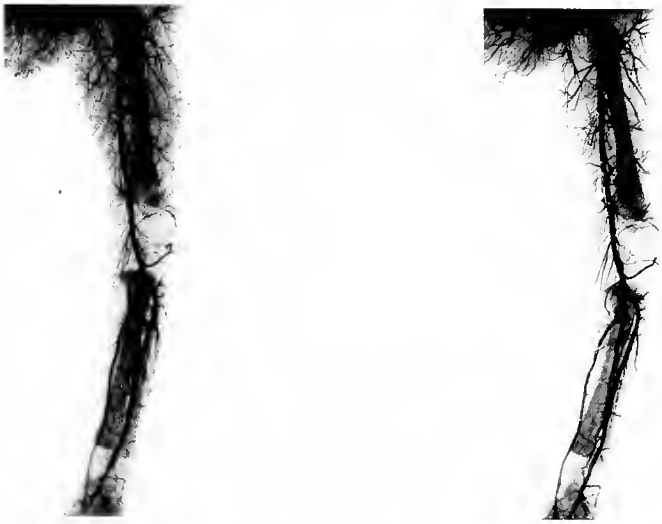
HAND.



ARM.



LEG.



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